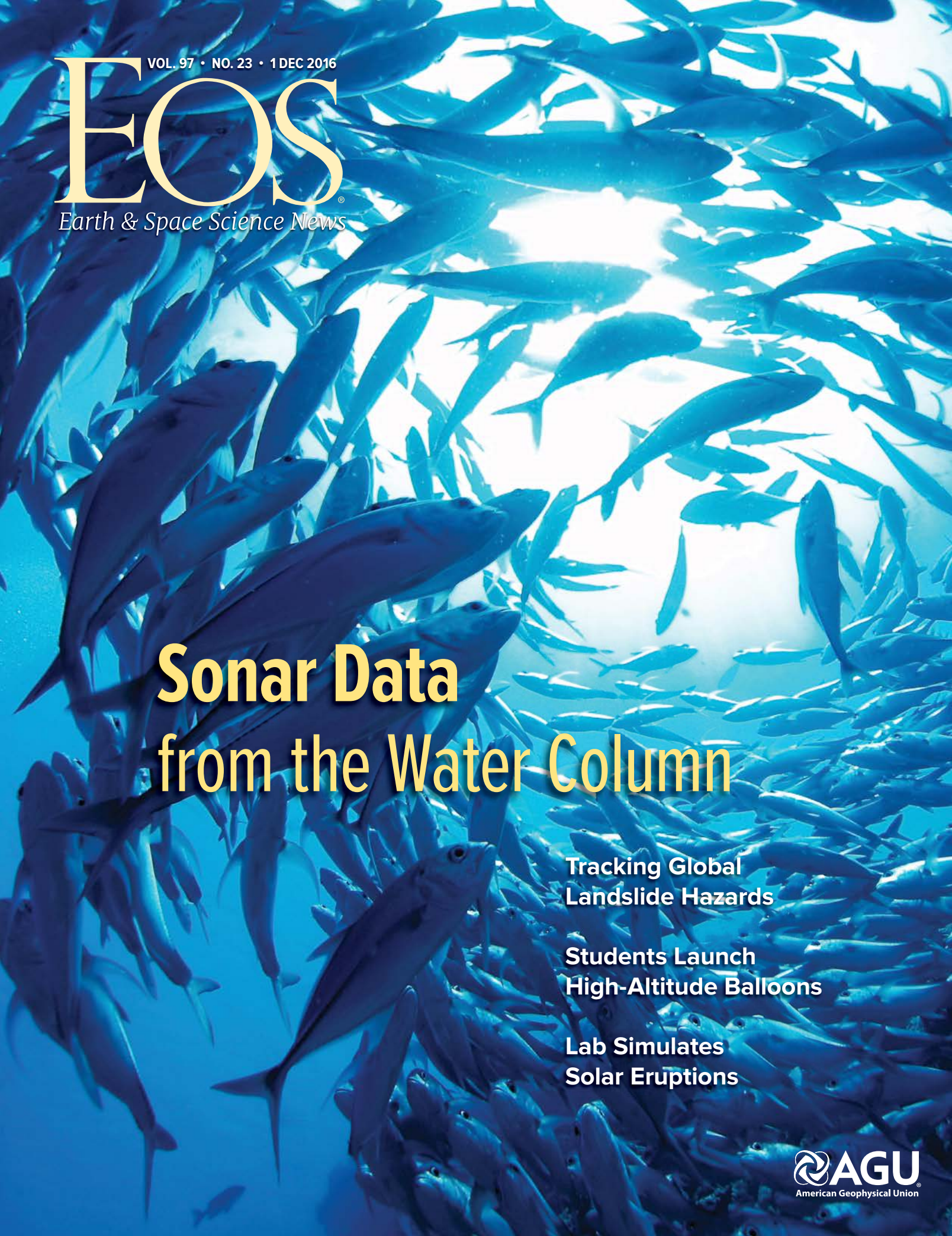
VOL. 97 • NO. 23 • 1 DEC 2016

EOS

Earth & Space Science News



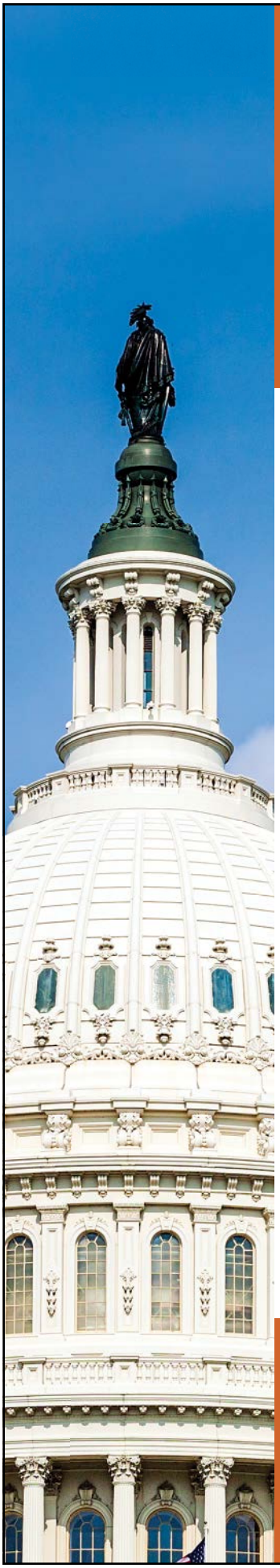
Sonar Data from the Water Column

Tracking Global Landslide Hazards

Students Launch High-Altitude Balloons

Lab Simulates Solar Eruptions

AGU American Geophysical Union



Science Policy at Fall Meeting:

New Congress, New Opportunity

Monday, 12 December

One-on-One with an Attorney
8:00 A.M. – 3:00 P.M.
Moscone South, Meeting Place,
South Bridge, Build Out #1

How to be a Mass Media or Congressional Science Fellow
12:30 P.M. – 1:30 P.M.
Marriott Marquis: Golden Gate B

Wednesday, 14 December

One-on-One with an Attorney
8:00 A.M. – 3:00 P.M.
Moscone South, Meeting Place,
South Bridge, Build Out #1

AGU - CSLDF Legal Symposium
8:00 A.M. – 1:00 P.M.
Marriott Marquis: Salon 2

Science Policy 101: A Field Guide to Congress
12:30 P.M. – 1:30 P.M.
Moscone North, Room 123-124

Tuesday, 13 December

One-on-One with an Attorney
8:00 A.M. – 3:00 P.M.
Moscone South, Meeting Place,
South Bridge, Build Out #1

Science Policy Networking Lounge
12:00 P.M. – 1:30 P.M.
Moscone West: Room 2001A

Thursday, 15 December

One-on-One with an Attorney
8:00 A.M. – 3:00 P.M.
Moscone South, Meeting Place,
South Bridge, Build Out #1

Science Policy 201: Advocacy in Action
11:30 A.M. – 12:30 P.M.
Moscone West: Room 2001A

Schedule Your One-on-One with an Attorney

These brief 30-minute consultations provide an opportunity to ask any legal questions regarding your scientific work. Email lawyer@climatesciencedefensefund.org to set your appointment.

AGU
American Geophysical Union

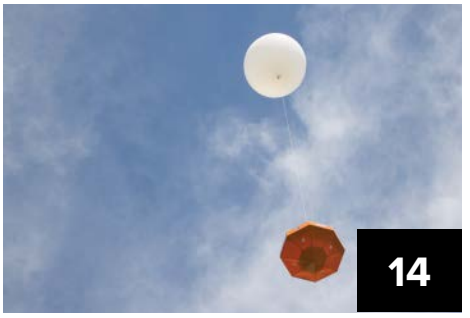
1 DECEMBER 2016
VOLUME 97, ISSUE 23

COVER

Building an Accessible Archive for Water Column Sonar Data

The Water Column Sonar Data Archive aggregates and curates sonar data sets from many sources, giving researchers access to much more information than they could collect on their own.

PROJECT UPDATE



Balloon Launches Introduce Students to Space Science

High school students launch their own high-altitude payloads and learn from their successes and failures through a science research training program led by the University of New Hampshire.

NEWS

Air Pollutant Plays Lesser Role in Climate Change Than Expected

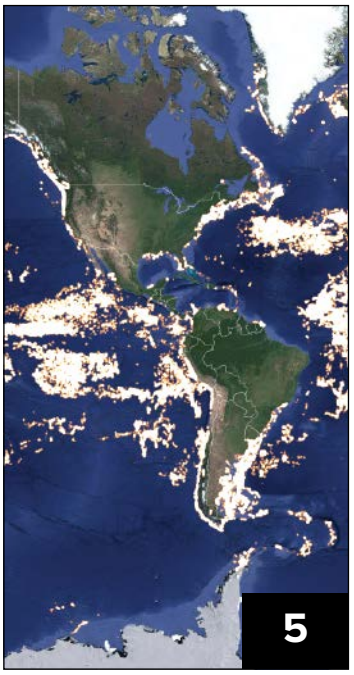
Satellite data indicate that pollution control efforts that curbed levels of sulfur dioxide gas did not cause a major decrease in carbon dioxide absorption by plants.

RESEARCH SPOTLIGHT

25 Mapping Water and Heat Deep Under Long Valley Caldera

Researchers use electrical resistivity to find the heat source and reservoir feeding Long Valley Caldera's labyrinthine hydrothermal system.

DEPARTMENTS



EOS.

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Christine W. McEntee, Executive Director/CEO

AGU American Geophysical Union

Tracking Landslide Hazards Around the World, Pixel by Pixel

REUTERS/Toru Hanai

Rainfall-triggered landslides in Hiroshima, Japan, killed dozens of people on 20 August 2014 after a month's worth of rain fell in one night, loosening slopes already saturated by prior weeks of rain. Soldiers searched for survivors amid dead trees and mud that smashed into homes.

An online tool debuted this fall that identifies in near–real time areas across the world where rainfall-triggered landslides are likely to occur. The lead researcher on the Landslide Hazard Assessment for Situational Awareness model, or LHASA for short, described the new "nowcast" publicly for the first time at the Geological Society of America annual meeting, in Denver, Colo. (see http://bit.ly/global-LHASA).

"It's the first type of system of its kind, for better or worse," said research scientist Dalia Kirschbaum of the NASA Goddard Space Flight Center in Greenbelt, Md. "It's meant as a tool to get a broad-brush understanding of potential areas of landslide activity…and it is a demonstration of how remote sensing data can be used at a global scale."

Rainfall-triggered landslides pose significant threats to life and property. Between 2007 and 2015, 7000 rainfall-triggered landslides killed more than 25,000 people and injured another 2000, according to NASA's Global Landslide Catalog (see http://bit.ly/GLCatalog). However, NASA Goddard scientist Thomas Stanley, who also works on the catalog, said that these are almost certainly underestimates of the damage because they rely on English language media reporting for details.

In addition to the loss of life, landslides cause billions of dollars of damage; in the United States alone, the U.S. Geological Survey (USGS) conservatively estimates that landslides generate $2–$4 billion in annual damages. Given these threats, there is a clear need for systems that highlight areas at risk from landslides, particularly in regions where data and communications are limited, Kirschbaum said.

Tracking Risk with Satellites

Wedding remote sensing measurements to complex computer programming, LHASA identifies areas susceptible to landslides around the world on the basis of a suite of environmental variables, including topography, geology, road networks, fault zones, and forest loss. The model, presented by Kirschbaum on 28 September, also tracks the preceding 7 days of precipitation at those locales using the Global Precipitation Measurement (GPM) satellite network.

When rainfall is high in susceptible areas, either cumulatively for the week or for the current day, the system issues a nowcast alert—a term borrowed from meteorology—that identifies areas with a high or moderate landslide probability. Updating every 30 minutes, the system responds quickly to changing conditions but can't predict landslides, according to Kirschbaum.

Although LHASA is not the only landslide alert system in the world, it's the first and only system to attain a global reach, Kirschbaum said. Places like Japan and Hong Kong use high-tech landslide alert systems, and the USGS has experimented with a system in the San Francisco Bay Area, but these operate on a regional scale only.

Pros and Cons of the Broad Brush

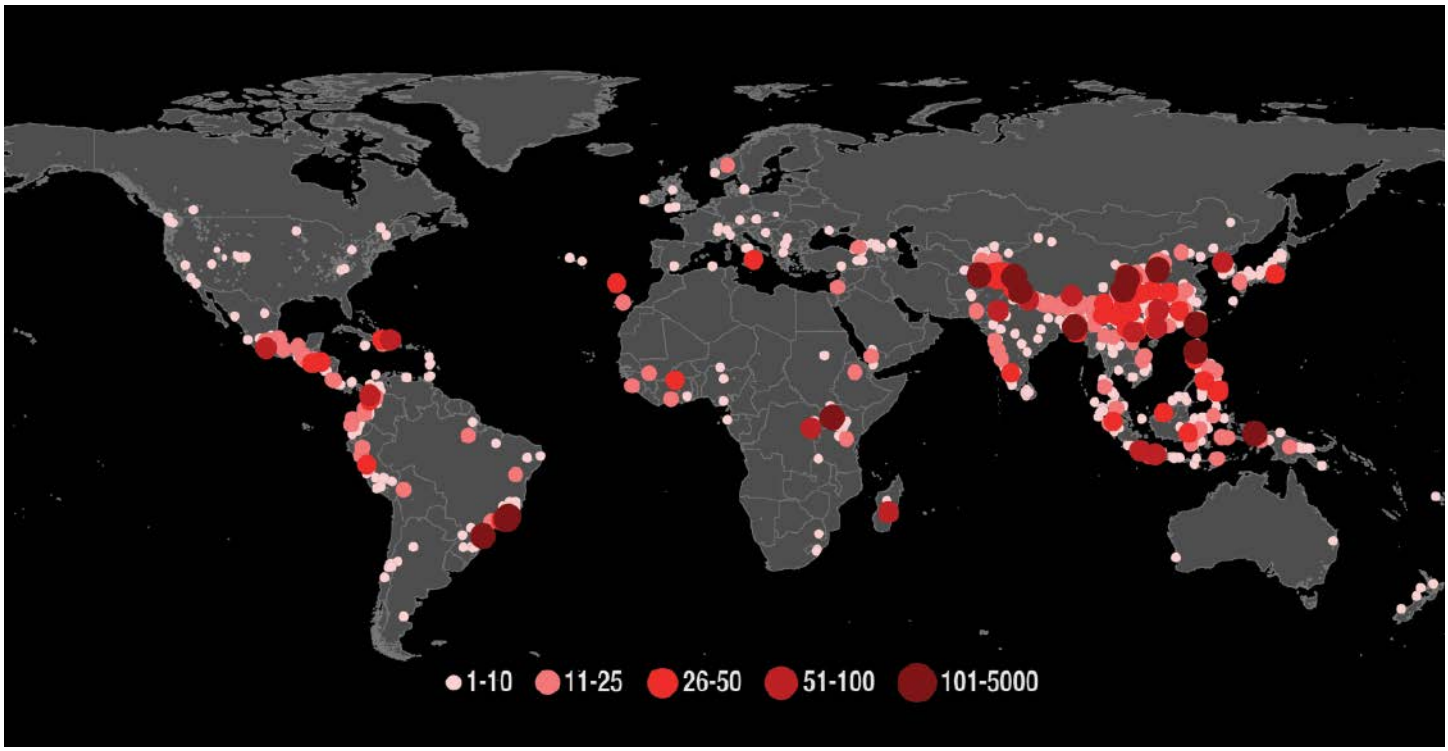
Other hazard scientists gave the new model mixed reviews in interviews with *Eos*.

Geographer and landslide expert David Petley at the United Kingdom's University of East Anglia called the model "an excellent development for identifying potential problems across a region. … It will permit wide-area analysis and preparedness and marks a step toward better understanding [landslide hazards]." Petley is the author of *The Landslide Blog*, an editorially independent blog hosted by AGU.

However, he noted that because the model depends on satellite data limited to 1-kilometer resolution, it could miss finer-grain conditions and events that cause many landslides, like degraded slopes or highly localized heavy rainfall. Nevertheless, the model's assessments should increase the chances of recognizing pending landslides in remote locations, where communications are difficult, and thereby improve rescue response, he said.

Landslide hazards coordinator Jonathan Godt, of the USGS Geologic Hazards Science Center in Golden, Colo., noted that nothing currently provides a comprehensive understanding of where rainfall-triggered landslides occur around the world. By collecting and displaying landslide-related information across the whole spectrum of climates and geological settings, the model will likely help researchers better understand these hazards. But, he cautioned, only time will tell whether response and aid agencies find the nowcasts helpful.

Godt also echoed a weakness of the new system that Kirschbaum had mentioned to *Eos:* the potential for overlooking contributions of gradual or seasonal rainfall to landslides. For example, both noted, the landslides in Oso, Wash., in 2014 were partly caused by weeks of rain and degraded hillslopes. The model, which does not factor in ground satu-



NASA Goddard Space Flight Center

A map of fatal landslides triggered by rainfall across the world from 2007 to 2013. Dalia Kirschbaum of the NASA Goddard Space Flight Center and her team developed this map from the Global Landslide Catalog, which is used to calibrate the Landslide Hazard Assessment Model for Situational Awareness.

ration, would likely not have identified the hazard as the soil slowly soaked up the rain.

Toward Forecasts?

The development of LHASA culminates many years of research into rainfall-triggered landslides. Since 2007, Kirschbaum and her team have compiled a database of landslides around the world. The Global Landslide Catalog, which is used to calibrate LHASA, contains more than 8000 landslides documented from media reports, online disaster databases, and other sources. The model also incorporates the primary elements from Kirschbaum's previous work, a regional model for Central America and the Caribbean.

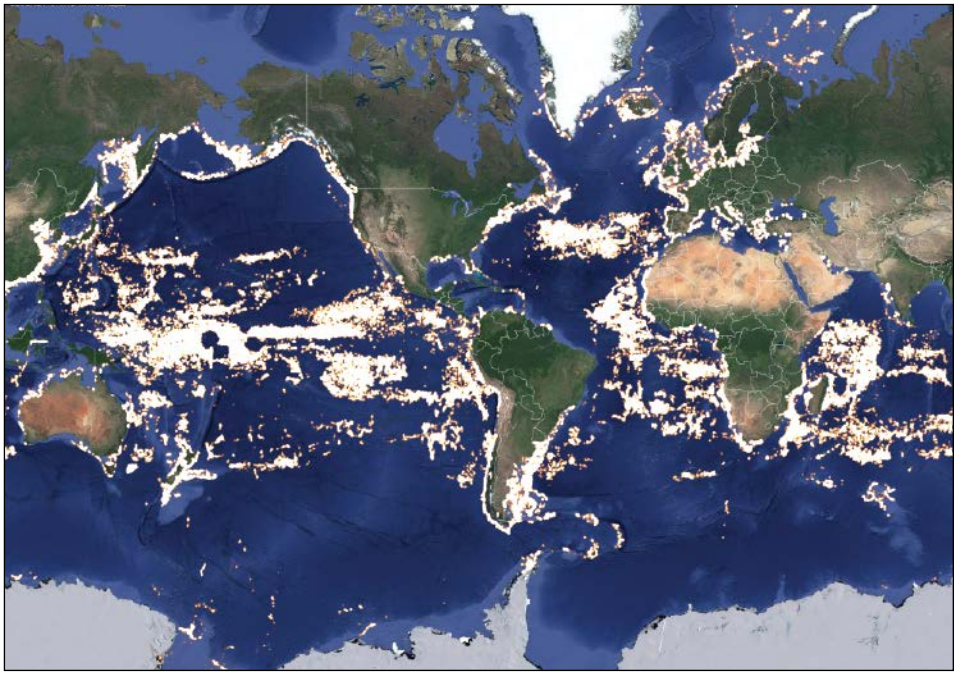
Kirschbaum concedes that the new model, now available in beta version (http://bit.ly/precip-apps), has limitations. However, she is hopeful that it can provide a big-picture view and fill in data gaps for far-flung reaches of the planet. Ideally, she told *Eos*, a global model would combine highly focused regional models, but given the dearth of landslide data and in situ service data in some regions, that is not possible.

Although the model was only recently released, Kirschbaum is already weighing her future ambitions for the project. She said she hopes to develop a citizen science effort to further bolster the landslide catalog. She would love to see the model, which was developed as open-source software and has publicly available and free data, adopted and improved upon, eventually allowing scientists to forecast landslides before a storm even hits.

That will have to wait until a later date, however. "There are a lot of lofty goals," Kirschbaum said. "But this is the first step."

By **Aaron Sidder,** Freelance Science Writer; email: aaron.sidder@gmail.com

Online Tracking of Ships Fights Illegal Fishing Worldwide



Global Fishing Watch

An image taken from an ever changing online display by Global Fishing Watch of commercial fishing activity. Along the coasts and in the seas, brown dots and white patches (where large numbers of dots are clustered) mark the presence of commercial fishing vessels. In this view of the map, every dot represents an instance of a vessel engaged in apparent gear-in-the-water fishing activity over the course of a 171-day window (3 February 2015 to 24 July 2015).

When the Republic of Kiribati established its Phoenix Islands Protected Area in 2006, the central Pacific island nation at first kept 88% of the 408,250-square-kilometer marine reserve open for commercial fishing. That changed dramatically in January 2015, when the country made the area a no-take marine reserve.

A new technology that uses satellites and online mapping to display locations of commercial fishing vessels has proven the effectiveness of that no-take decision and helped Kiribati enforce the restriction. From January to October 2014, 155 vessels likely spent more than 5000 fishing days within the reserve, but only 12 ships spent a likely 16 days fishing there during the same period in 2015, according to data derived from Global Fishing Watch (GFW), the new system that tracks the vessels in near-real time.

A video showing GFW-plotted fishing vessels in the region around Kiribati's Phoenix Islands Protected Area from August 2014 into June 2015 reveals a steep decline in apparent fishing activity in the reserve following the no-take decision (see http://bit.ly/pipa-closure).

The public beta version of the monitoring tool was launched in September at the international 2016 Our Ocean Conference in Washington, D. C. There, actor Leonardo DiCaprio announced this novel way "to address global overfishing and illegal fishing." Several funders have supported development of the new system, the largest being a foundation established by and named for DiCaprio.

Tracking Ships Through Shipborne Signals

GFW not only tracks vessels but also uses algorithms to analyze those tracks to determine whether a vessel is probably taking fish in a particular area. GFW receives signals from the widely used shipborne Automatic Identification System (AIS), which it uses to project points of light representing ship locations onto a global digital map that anybody with Internet access can view for free.

The platform currently tracks more than 35,000 large commercial marine fishing vessels. Over time, plans call for GFW to track an increasing number of the estimated 64,000 marine fishing vessels that are at least 24 meters long, as well as many smaller ships.

Drawing Attention to Illegal Fishing and Overfishing

AIS signals, which aid collision avoidance and provide ship identifications and locations, now can help draw attention to overfishing and illegal fishing, according to GFW experts.

"For the first time ever, we are trying to bring transparency to commercial fishing worldwide, for the general public for free," Adam Reyer, GFW project director for Oceana, an ocean conservation advocacy group based in Washington, D. C., told *Eos.* "You can't solve the ocean sustainability problem without being able to see what's going on."

To develop the tool, Oceana partnered with two other organizations: SkyTruth, a nonprofit based in Shepherdstown, W.Va., that uses satellite imagery and remote sensing to monitor the environment, and Google, the computer giant based in Mountain View, Calif.

Millions of Data Points Each Day

About 22 million AIS data points showing ship positions are added to the system each day, Brian Sullivan, Google lead for GFW and senior program manager for Google Ocean and Earth Outreach, told *Eos*. ORBCOMM, a company headquartered in Rochelle Park, N.J., provides those coordinates to GFW on a 72-hour delay to avoid competing with the sale of the company's real-time data.

Sullivan said that research partners and fishery experts manually classified thousands of ship tracks to teach the system's algorithms how to determine, by a ship's speed, direction, and turning rate, whether it might be involved in fishing activities. "Anyone in the world can go in, click on vessels, see who's fishing, where they're fishing, and how that's changing over time," he said.

Using Data for Decisions

Several factors may limit the effectiveness of GFW at countering unsustainable and illegal fishing practices, some of the system's developers and users said. Ships tracked by GFW represent only a small percentage of marine fishing vessels worldwide, which are numbered at 3.2 million by the United Nations Food and Agriculture Organization. (The majority of these are local, small wooden

boats, according to SkyTruth.) Many small ships don't have or use AIS, with some purposely choosing to remain dark, possibly to cloak fishing activities. What's more, the algorithms aren't yet perfect, so some suspect ships may be involved in nonfishing activities. But those familiar with the system point to the number of large ships already tracked and the increasing use of AIS and say that GFW information can help curb overfishing and illegal fishing.

"To see where all the fishing is is important because a lot of people are making decisions about fishing, protecting the oceans, or supporting industry [that is] utilizing the oceans. Those decisions are made often in the context of not a lot of data," said Paul Woods, chief technology officer for SkyTruth, a group that got a lot of attention for analyzing the 2010 Deepwater Horizon oil spill using satellite technology. Publishing the data can help people make more informed decisions, Woods added.

Research Program

In addition to decision makers using the data, GFW set up a research program to make use of the data. At the 2016 AGU Fall Meeting, researchers will give a series of oral (see http://bit.ly/OS14A) and poster (see http://bit.ly/OS11A) presentations that incorporate GFW data.

Presentations include "A Global View of Large-Scale Commercial Fishing," "Estimating Clandestine Activities from Partially Observed Processes," and other topics.

It's Public Now

For SkyTruth president John Amos, the big deal with GFW is that the data are public now. Amos, a geologist by training and a former oil company research scientist, said that although governments and industry have had access to this type of data for a while, the public "has never been able to see where all of this fishing effort is happening" throughout the ocean.

The reaction of people to seeing the "scope and intensity of this fishing" is "shock," Amos added. "It's just the pervasiveness of fishing throughout the ocean. It's a visual picture of the human footprint of intervention."

Amos said that GFW "is providing measurable data that scientists and policy makers can use to create better management schemes and policies to move our fisheries toward sustainability. That's the vision. We have a long way to go to get there."

By **Randy Showstack,** Staff Writer

Air Pollutant Plays Lesser Role in Climate Change Than Expected

Cathy, CC BY-NC 2.0 (http://bit.ly/ccbync2-0)

Sulfur dioxide comes mainly from coal-burning power plants and other industrial processes. Scrubbers installed at many coal-fired electricity-generating plants like this one in West Virginia reduce emissions of the gas.

Scientists have long thought that the aerosols derived from sulfur dioxide helped land vegetation in a big way to absorb the greenhouse gas carbon dioxide (CO_2) during photosynthesis. But a recent study examining how vegetation across the eastern United States responded to decreasing levels of sulfur dioxide (SO_2) from 1995 to 2013 suggests that the link between SO_2 and photosynthesis—and thus CO_2 levels—may not be so strong after all.

"Over 19 years, sulfur dioxide emissions fell by about 70%…while photosynthesis only decreased by 1%," said Gretchen Keppel-Aleks, an atmospheric scientist at the University of Michigan, Ann Arbor, and lead author of a recent study in *Geophysical Research Letters* (*GRL*; see http://bit.ly/SO2-paper). "This is good news, since it means that we can go ahead and improve air quality by regulating sulfur dioxide, all while having a minimal impact on the climate," she added.

The new finding, although revealing more about how SO_2 behaves, deepens a climate mystery, Keppel-Aleks explained: Each year, land ecosystems absorb about 25% of the CO_2 that humans emit, even though our CO_2 output increases more and more each year.

Why the land carbon "sink" can keep pace with skyrocketing CO_2 levels eludes explanation.

Now, with the role of SO_2 in doubt, researchers will need to explore new possibilities in the "hunt for where anthropogenic carbon is going in the terrestrial biosphere," Keppel-Aleks said. They also might need to carry out new observations because the field is "observationally poor compared to what we would like in order to actually unpack what's driving the global carbon sink," she added.

Sulfur Dioxide's Scattering Effects

In the air, SO_2 reacts with oxygen to form sulfate ions, or SO_4^{2-}. In many humid, eastern U.S. states, intense hazes form when sulfate particles take up water, making them swell and boosting their efficiency at scattering sunlight, said Jenny Hand, an atmospheric scientist at Colorado State University in Fort Collins, who was not involved in the new work.

Apart from scattering light and creating haze, SO_2, emitted from coal-fired power plants as well as during other industrial processes, can cause acid rain and respiratory health problems. These are a couple of reasons the United States' 1990 Clean Air Act amend-

ments mandated SO_2 emission curbs, which brought on the 70% drop in emissions from 1995 to 2013, Keppel-Aleks explained.

This decline provided "a great test case," Keppel-Aleks said, which gave her and her coauthor, Rebecca Washenfelder, an atmospheric scientist at the University of Colorado Boulder, the chance to run a climate model using real-world data. Previous studies mostly just used modeling, she explained, but "if you're going to run a model, you should probably try to evaluate it against something you can see in the Earth." So the team incorporated the eastern U.S. SO_2 data into the Community Earth System Model (CESM), which can simulate the climatic effects of the pollutant's decline.

Less sulfate means less scattered, or diffuse, light. This scattering was thought to boost photosynthesis. "If you've got a nice parallel beam of light coming toward trees, then the leaves at the top of the canopy will be the only ones absorbing photons, while leaves deeper in the canopy are just sitting there doing nothing," Keppel-Aleks said. But when light scatters, "you've got photons that are coming at the canopy from multiple different angles," and the leaves below the canopy surface can now also photosynthesize, she added, which was believed to help the land carbon sink keep pace with the rise of anthropogenic CO_2 emissions.

To quantify sulfate's effect on incoming light, the team measured the aerosol optical depth (AOD), or the extent to which aerosols like sulfate absorb or scatter light. They found that AOD "decreased by almost 50%" from 1995 to 2013, said Keppel-Aleks, whereas photosynthesis decreased very little. These numbers show that in the kinds of temperate ecosystems she and Washenfelder examined, at least, "there's a very weak link between diffuse light and carbon uptake," Keppel-Aleks explained.

Reto Stöckli, NASA Earth Observatory

Artist's conception of NASA's Aqua satellite, launched in 2002, which collected land vegetation data used in a new study of the effect of sulfur dioxide–caused haze on carbon dioxide sequestration by plants.

A More Realistic Picture

Each year between 2000 and 2009, vegetation removed about 27% of the roughly 7.8 petagrams, or 7,800,000,000 metric tons, of carbon then emitted annually, on average, by humans. Before the new *GRL* paper, SO_2 was thought to help remove as much as 5 petagrams of carbon every year by helping stimulate photosynthesis (see http://bit.ly/tellusb-paper-2014).

"That's an insane number, and a lot of people were questioning it," said Natalie Mahowald, an atmospheric scientist at Cornell University in Ithaca, N.Y., who was not involved in the new work. CESM, though, "very carefully constrains the relationship between incoming solar radiation" and how much photosynthesis occurs, so "the new number they devised in this paper makes a lot more sense," she said. Now, according to the new study, it seems that photosynthesis stimulated through SO_2 removed just 0.5 petagram of carbon in total between 1995 and 2013.

Rooted in Field Data

In a 2015 field study, other scientists recorded how photosynthesis varied under both diffuse and direct light conditions (see http://bit.ly/cheng-et-al). Strengthened by that prior research, the new findings are "realistic and definitively show that the link between scattered light and photosynthesis is not important in temperate ecosystems," Keppel-Aleks said.

But the field data came from only four sites in the eastern United States, so the team used data from the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument on NASA's Aqua and Terra satellites to extrapolate the observed relationships between diffuse light and photosynthesis to the whole eastern United States. The researchers then compared those results with their CESM simulation. "The results agreed with the climate model results to within 20%, which is quite good," Keppel-Aleks said.

The new findings, published on 28 September, also mean that cleaning SO_2 out of the skies will not cause CO_2 levels in the atmosphere to then spike, as SO_2 does little to help draw CO_2 out of the air, Mahowald said. But sulfate, when it scatters solar radiation, can cause some light to escape back out into space, which helps cool the planet. "There's this double whammy that's going on: As we clean up the air quality, we may well see slightly warmer temperatures."

By **Lucas Joel,** Freelance Writer; email: lucasvjoel@gmail.com

AGU Should Sever Its Ties with ExxonMobil

For decades, ExxonMobil has engaged in a campaign of disinformation: funding individuals and organizations committed to portraying climate change as highly uncertain, if not a hoax; questioning the motives of climate scientists; and targeting researchers for personal attacks aimed at discrediting their findings.

ExxonMobil executives have repeatedly suggested in speeches, in interviews, and in "advertorials" that climate science was too unreliable to be trusted as a basis for policy making. Flying in the face of peer-reviewed economic studies, they have also insisted that the costs of mitigating climate change would be greater than the benefits.

Given these facts, it baffles us that AGU continues to accept money from ExxonMobil. The more than half a million dollars of ExxonMobil money that AGU has accepted over the past 15 years violates AGU's own policy on accepting funding from groups that peddle misinformation.

This fall, AGU reaffirmed its perplexing stance. On 23 September, its Board of Directors chose not to sever ties to ExxonMobil funding, despite receiving a detailed report from AGU members that demonstrates that ExxonMobil is still in the business of disinformation (see http://bit.ly/disinforeport).

We urge AGU's Board of Directors to reverse its decision. Not only is AGU's integrity as a scientific society at stake, but so too is the integrity of the scientific process.

ExxonMobil's Campaign of Disinformation

ExxonMobil's systematic attacks on climate science are well documented. They have been detailed by our fellow scientists, as well as by us—indeed, we ourselves have been targets of ExxonMobil's repeated attacks. ExxonMobil's assault on climate science has been documented in the scholarly research of historians and sociologists who have taken up the issue of attacks on science as a question of academic scholarship. The attacks have also been heavily explored by journalists, science advocacy organizations, and filmmakers.

What's more, ExxonMobil's attacks on climate science are not a thing of the past. The report by AGU members sent to AGU's Board on 25 March 2016, ahead of their 6–7 April Board meeting, documented an exhaustive body of evidence supporting the fact that ExxonMobil "continues to generate its own misinformative comments, fund groups that promote climate science misinformation, and financially support more than 100 climate-denying members of Congress."

Moreover, "despite stating publicly in 2008 that it would no longer support climate science misinformation, ExxonMobil has continued to make public statements disparaging the validity of climate science and to financially support others who do the same."

iStock.com/Stephan Zabel

Strange Bedfellows

The fact that AGU accepts this money is a clear violation of AGU's Organizational Support Policy. The policy states, "AGU will not accept funding from organizational partners that promote and/or disseminate misinformation of science, or that fund organizations that publicly promote misinformation of science."

It is precisely because ExxonMobil so clearly fails to meet the standard of this policy that more than 100 leading AGU members, including the three of us, were signatories to an open letter last February urging AGU to sever its ties with the company (see http://bit.ly/open-letter-2AGU).

The letter noted that "AGU has established a long history of scientific excellence with its peer-reviewed publications and conferences, as well as a strong position statement on the urgency of climate action. But by allowing Exxon to appropriate AGU's institutional social license to help legitimize the company's climate misinformation, AGU is undermining its stated values as well as the work of its own members."

The letter called on President Margaret Leinen "to protect the integrity of climate science by rejecting the sponsorship of future AGU conferences by corporations complicit in climate misinformation, starting with ExxonMobil."

Given the conflict between our society's policies and ExxonMobil's documented activities, we believed that AGU would take steps to disassociate itself from that company.

> ExxonMobil's attacks on climate science are not a thing of the past.

AGU's Unchanged Position

After deliberating on the matter for several months, in April President Leinen and the AGU Board of Directors decided otherwise.

Their justification rested on a legalistic interpretation: "It is not possible for us to determine unequivocally whether ExxonMobil is participating in misinformation about science currently, either directly or indirectly, and…AGU's acceptance of sponsorship of the 2015 Student Breakfast does not constitute a threat to AGU's reputation."

In response, two congressmen—Sen. Sheldon Whitehouse (D-R.I.) and Rep. Ted Lieu (D-Calif.)—wrote a letter to President Leinen. ExxonMobil was still funding "several organizations that cast doubt on climate change," they explained, offering recent examples that connect the corporation to organizations that peddle climate change misinformation (see http://bit.ly/Lieu-letter). They urged AGU to make decisions independent of "self-serving representations by ExxonMobil."

This letter prompted the Board to meet to reconsider its decision. Sadly, on 23 September, the Board announced that its position was unchanged.

AGU's Double Standard on Scientific Integrity

As one of us told *Inside Climate News* after the Board's first decision in April (see http://bit.ly/McKenna-Hirji), AGU's actions make "a

mockery of its own [policy] that states that it will not accept funding from disseminators of disinformation. If the AGU cannot turn down a mere $35K [per year] from a high-profile disinformer like Exxon, then it is hard to imagine it ever adhering to its [policy]."

But this is not just about a breakfast. It is about AGU lending its imprimatur to an organization with a history of attacking AGU's own members. It's about the "social license," to quote the February open letter, that AGU provides for ExxonMobil to continue with such attacks.

It's also about scientific integrity.

For more than 2 decades, ExxonMobil and its allies have consistently downplayed, disparaged, and in some cases rejected outright the evidence that scientists have painstakingly gathered. Such actions are the antithesis of the spirit of the scientific endeavor.

As scientists, we are committed to drawing conclusions based on evidence. That is why AGU's recent decision is so shocking. By rejecting the evidence of ExxonMobil's antiscientific activities, AGU not only validates ExxonMobil's disregard for facts but also showcases its own willingness to abandon them.

The message is clear: AGU does not require its funders or itself to be held to the same standards of evidence-based scrutiny that it expects of the scientists who publish in its own journals.

Beware Third-Party Allies

The AGU Board's position seems to rest on the word "currently." Of course, we cannot prove what anyone is doing at any instant, particularly if they are doing it behind closed doors.

One of the key findings of scholarly research is that organizations that disparage scientific findings typically do so through such "third-party allies" as think tanks and trade organizations so as to hide their unsavory activities from view. ExxonMobil has done this in the past, and we have substantial evidence that it continues to do so.

Among other things, it is a member of the American Legislative Exchange Council (ALEC), which has promoted state legislation—modeled on creationism—requiring school teachers to teach "both sides" of the climate change "debate." ALEC's website and speakers at its meetings suggest that the causes of recent observed warming are still not really understood and/or are "inevitable."

For this reason, many prominent corporations have severed ties with ALEC, including Google, Microsoft, Ford, Walmart, Unilever, Amazon, Coca-Cola, and Pepsi. As then chair of Google Eric Schmidt told the *Los Angeles Times* (see http://bit.ly/HalperALEC), "We should not be aligned with such people—they're just, they're just literally lying."

AGU does not require its funders or itself to be held to the same standards of evidence-based scrutiny that it expects of the scientists who publish in its own journals.

AGU Should Reject Funds from ExxonMobil

There is precedent for declining funding from an industry that has engaged in antiscientific activities. For decades, tobacco giants, including Phillip Morris and R.J. Reynolds, were generous funders of scientific and biomedical research, as well as the arts, museums, and even women's tennis. No doubt the recipients of those funds were appreciative of them.

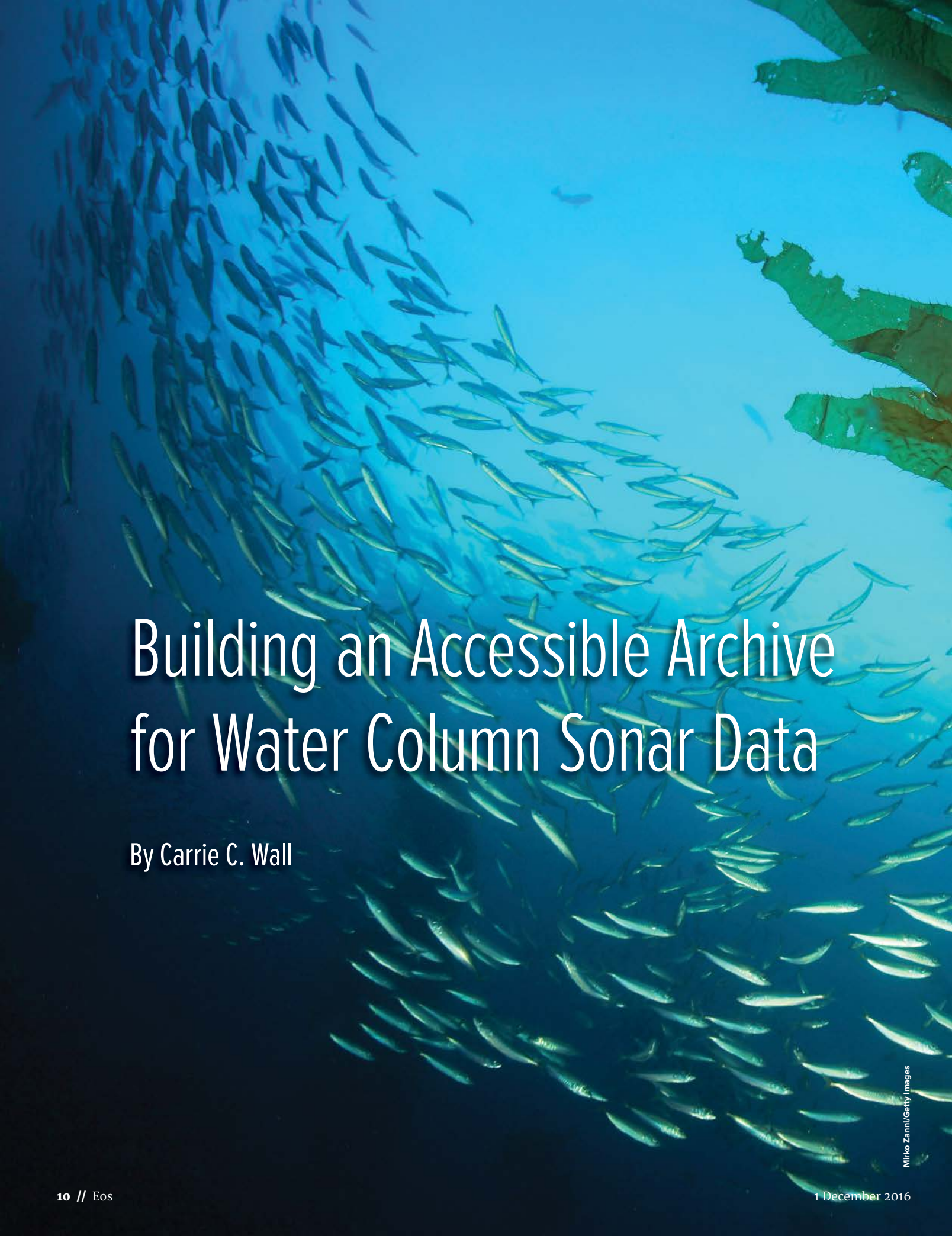
But when it became clear that these companies had worked to undermine the scientific evidence of the harm caused by their products, universities, medical schools, and schools of public health began to realize that they faced a dilemma. Yes, those funds were put to good use, but they were also used to buy credibility by an industry whose statements were not credible.

And so today, leading institutions, including the Harvard Medical School and Chan School of Public Health, the Johns Hopkins School of Public Health, the University of Texas, and many others, no longer accept tobacco money. At the University of California, San Francisco (a leader in tobacco control research), by the time the faculty voted formally in 2003 to institute a no-tobacco funding policy, the faculty had already come to that position de facto.

Some of our colleagues may feel that it is "political" to turn down such funds. But if declining funding indicates disapproval, then surely accepting it can be equally well interpreted as indicating approval.

We should not succumb to status quo bias. As a dean at the University of Texas told the *New York Times* (see http://bit.ly/tobacco-money) when explaining its decision to decline tobacco funding, "Just because it's green, we don't have to take it."

By **Michael E. Mann,** Department of Meteorology, Pennsylvania State University, University Park; email: mann@psu.edu; **Naomi Oreskes,** Department of History of Science and Department of Earth and Planetary Sciences, Harvard University, Cambridge, Mass.; and **Kerry A. Emanuel,** Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology, Cambridge



Building an Accessible Archive for Water Column Sonar Data

By Carrie C. Wall

Mirko Zanni/Getty Images

Many scientific disciplines use water column sonar data to map the ocean. Recent advances in sonar technology provide higher-quality data that result in larger data sets than ever before.

Sonar instruments emit sound pulses that reflect off objects in the water column. These instruments then measure the time and the angle of the return pulses to detect and locate those objects. Water column sonar data cover from the near surface of the ocean to the seafloor, so they can contain information on a variety of environmental characteristics. Fisheries researchers analyze these data to study the attributes of fish schools or to characterize the habitats of commercially and ecologically important fish and invertebrate species [*Simmonds and MacLennan,* 2005].

Combining sonar data with fisheries catch data helps inform management decisions, making sonar a valuable technology for ensuring the health of the fisheries' stocks. Water column sonar data can also be used to identify undersea oil plumes and natural methane gas bubbles being emitted from the seafloor [*Skarke et al.,* 2014; *Weber et al.,* 2012].

To increase data utility, a central data archive could provide a large volume of data that would enable researchers to examine water column habitats on scales and in areas that are impractical for a single researcher to obtain.

Acoustic surveys by the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) have collected more than 30 terabytes (TB) of water column sonar data, and they continue to collect more than 10 TB every year. The NOAA National Centers for Environmental Information (NCEI), in collaboration with NMFS and the University of Colorado, have established the Water Column Sonar Data Archive (http://bit.ly/sonar-data) to steward water column sonar data to preserve and make these data available for the next generation.

An Archive of Integrated Information

Since the Water Column Sonar Data Archive became fully operational in 2013, it has made more than 27 TB of raw sonar data available to researchers and the public worldwide. Sonar data sets were derived from multiple sonar instruments and include single-beam and multibeam systems with single and multiple frequencies. Low-frequency sonars running at 12, 18, and 38 kilohertz (kHz) are best for identifying some fish species and for reaching deeper depths, while higher-frequency sonars (120, 200, and 300 kHz) provide high-resolution data in shallow waters and are capable of discerning zooplankton and other small marine organisms.

Sonar is used to track fish populations, like this school of jack mackerel swimming in a kelp forest near Santa Catalina Island, Calif.

Water column sonar data archived at NCEI can be discovered, queried, and requested online via its website (http://bit.ly/sonar-viewer). The website also contains information on cruise tracks that illustrate the geographic area covered by each survey. Once a user selects a cruise, the site displays metadata entered by the data provider. These metadata inform the reader of details about the cruise, including time period, principal investigator, and organizations involved in the data collection.

Since the Water Column Sonar Data Archive became fully operational in 2013, it has made more than 27 terabytes of raw sonar data available to researchers and the public worldwide.

Raw data files come in proprietary formats, and reading them requires specialized acoustic processing software or knowledge of a scientific programming language. Although users who wish to use the raw acoustic data must provide these capabilities on their own, NCEI is developing visualization tools that anyone can use to quickly and easily illustrate data taken at one or more frequencies in a single image by depicting the dominating frequency or frequencies [*Wall et al.,* 2016]. These images are being incorporated into the website.

Integrating interactive science with the archived raw data will help users determine whether the files are relevant to their research objectives. These steps aim to save time for both the user and the archive staff and will ultimately lead to a more efficient system by reducing unnecessarily large data requests.

Putting the Data to Use

Through proper management of the data, sonar systems can deliver valuable information beyond their original collection purpose. For example, comparisons of two sonar frequencies (38 and 120 kHz) have been used to distinguish between zooplankton, such as krill, and fish [e.g., *Lawson et al.,* 2008; *Madureira et al.,* 1993]. Thus, a single instrument using these two frequencies can reveal a predator-prey distribution. Figure 1 illustrates the location of such data collected in 2013 by NMFS that are available in the archive. These data could further be used to identify the presence of methane seeps emanating from the seafloor [*Weber et al.,* 2012]. In addition to analyses on a cross-basin scale, studies examining multiple years are also feasible using archived data sets that were repeated annually in the same region.

Sonar data within the archive date back to 1998, and data from sophisticated multiple-frequency multibeam sonar systems are available beginning in 2010. The archive contains historic (Simrad EK500) sonar data collected at 38 and 120 kHz for 52 cruises conducted between 1998 and 2007 located on the western and northeastern coasts of the United States. Similar data collected using a newer (Simrad EK60) system are available for 131 cruises conducted between 2003 and 2016 in all coastal regions of the conti-

A community of mussels thrives on chemicals seeping from the deep ocean floor, like these gas bubbles (likely methane) rising in the water column. An expedition in 2011 confirmed that the National Oceanic and Atmospheric Administration Okeanos Explorer*'s multibeam sonar could detect gas in the water column.*

NOAA

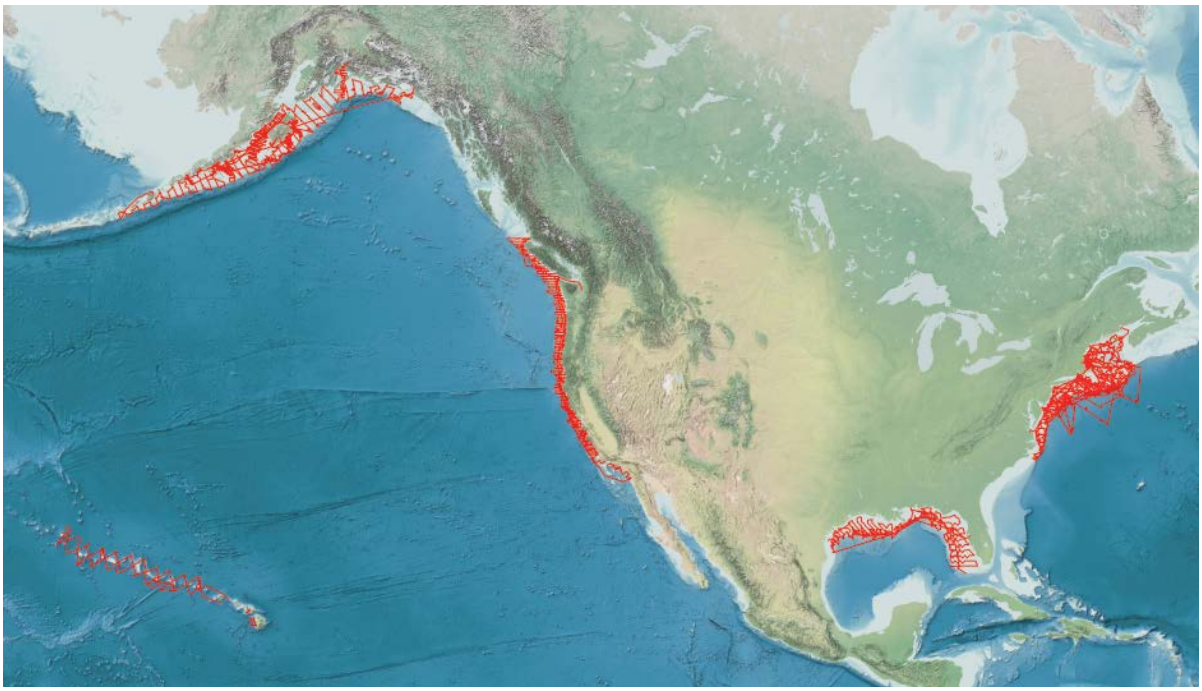


Fig. 1. The Water Column Sonar Data Archive aggregates data from many sources. Areas in red show locations where archived water column 38- and 120-kilohertz sonar data were collected in 2013 by National Marine Fisheries Service surveys. These data comprise more than 47,000 files and 2.11 terabytes.

nental United States, Puerto Rico, Guam, and the tropical Pacific and off the Palmer Archipelago in Antarctica.

As we work with NOAA and other researchers to archive more data sets in the near future, we will continue to increase the range (spatial and temporal) of data available. The centralized location of and global access to an expansive data set enable researchers to explore marine acoustic research on scales that would have been impossible if they had to collect the data themselves.

The archive's website also provides the data on conductivity, temperature, and depth (CTD data) associated with a cruise when possible. The NCEI World Ocean Database (http://bit.ly/ocean-database) subjects these data to quality control standards, and the data are used to calculate sound velocity profiles for further processing of the water column sonar data.

An Evolving Resource

Archived water column sonar data are freely available and accessible online using the website (http://bit.ly/sonar-viewer). Data citation information is provided for the archived cruises so that any reuse can be attributed to the original data collector.

This is a relatively new endeavor, so the volume of data and number of sonar systems available from the archive will continue to grow as more data are collected and submitted to NCEI. If you are interested in archiving your water column sonar data, please write to wcd.info@noaa.gov to receive information on that process.

Acknowledgments

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Balloon Launches Introduce Students to Space Science

By Charles W. Smith, Peter F. Bloser, Noe Lugaz, Louis Broad, Scott Goelzer, and Richard A. Levergood

Students from three New Hampshire high schools gathered on a soccer field at midnight. After months of working together to prepare a payload for a flight to the edge of Earth's atmosphere, just into space, their launch vehicle was ready.

The payload had been tested and retested. The flashing strobe beneath the payload—required so that aircraft can see the balloon—was lit. The countdown reached zero, and their high-altitude balloon, carrying a payload of cameras and instruments, began its journey to 30,000 meters above Earth.

During the balloon's flight, the student-designed instruments would measure cosmic radiation. At its zenith, cameras would attempt to capture an image of the Earth's light at night.

However, at 500 meters, the payload broke free of its balloon, fell to Earth, and landed in a lake across the street from the launch site.

"Good! Now they get to see that we learn from our mistakes," said a school board member who watched the failure. Indeed, the students went back to the drawing board; 2 months later, the system launched successfully.

Both launches were part of an outgrowth of a summer research program involving high school students and teachers at the University of New Hampshire (UNH). For 25 years, UNH has run a summer residential outreach program for high school students called Project SMART (Science and Mathematics Achievement through Research Training).

Students in Project SMART choose one of three separate modules for their summer experience: biotech and nanotechnology, marine and environmental science, or space science. Here we report on strategies used and successes from the space science module.

An Overview of Project SMART

UNH's SMART space science module involves two phrases. First, three local high school physics teachers join with university faculty to welcome roughly 14 students from around the world who attend UNH for a monthlong summer school program. There, students learn core space science and astrophysics ideas while developing new skills and getting what is often their first insight into what careers in science are really like.

A high-altitude balloon launch from July 2014 with a payload, designed by students, below the ascending balloon. The students were part of the University of New Hampshire's Project SMART (Science and Mathematics Achievement through Research Training).

UNH

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Fig. 1. Photo from 31,000 meters taken by the high school flight in November 2015. Students from New Hampshire's Coe-Brown, Londonderry, and Timberlane high schools worked together to make this flight a reality. Note the black of space and the pale blue band that is our atmosphere.

In the mornings the students attend lectures in advanced high school and early college physics and demonstrations provided by the teachers, as well as seminars provided by UNH faculty. They also receive instruction in building and manipulating electronic circuits. The work culminates in the launch of a high-altitude balloon that carries the student-built instruments into the stratosphere.

In the afternoons the students work with UNH professors using real spacecraft data and hardware. They do genuine research and often investigate ideas the faculty are considering—this early work can often open a subject for future efforts by the faculty.

The second phase occurs during the school year. The three high school teachers involved in SMART bring the summer lessons back to their schools to give their students extra experience, beyond what their curricula require. For example, students work with circuits, study cosmic rays, explore principles of thermodynamics, and develop hardware for their own balloon launch. By the end of the school year, all the high school students gather for their own balloon launch.

Approximately 70 students have participated in the Project SMART space science module during summers at UNH since 2010. The outreach program to the local high schools has involved more than 200 students in engineering and science projects.

About one third of the participants in the SMART summer program are women, and one third are minorities. The percentage of young women participants increases dramatically when we include the participation at the local high schools. The addition of international students further energizes the program.

Readying Balloons for Launch

Constructing a scientific payload for a high-altitude balloon flight has been Project SMART's summer team project for the past 9 years.

The balloon program is a direct outcome of an earlier program at Timberlane Regional High School in Plaistow, N.H., that combined mathematics and physics in the school curriculum. The payload contains cameras as well as instruments built by the students, for example, a Geiger counter, a Sun sensor, an Earth-imaging spectrometer that ranges from the infrared to the ultraviolet, and flight control circuits.

Science motivates our balloon flights, and we always include at least one camera. For still photographs, the Canon company provides a large set of "hacks" for its cameras that enable the students to program the camera to function during the entire flight. Photographs from 30,000 meters (Figure 1) never cease to amaze.

During the flight, instruments send a signal when the onboard GPS reports that the balloon has crossed the preset flight boundaries. A nichrome wire cuts the line to the

balloon, thereby dropping the payload. An inexpensive Flip camera records video images, which include capturing the moment when the balloon ruptures (Figure 2).

Designing Instruments

We attempt to refine or initiate new science with each balloon flight. This has driven a program of unanticipated problem solving that lies at the heart of the student experience.

For instance, early in the program, onboard video revealed that the payload tumbles when the balloon bursts at altitude. This tumbling wrapped the parachute around the payload, so that the payload went into free fall.

To solve the problem, students at Timberlane Regional High School built a wind tunnel and experimented with different designs until arriving at the current flight concept, which does not require a parachute (Figure 3). When the payload is properly balanced, it descends with very little rotation and remains upright. Students at Coe-Brown Northwood Academy in Northwood, N.H., optimized the final shape and refined the construction using rigid pink insulation and a model airplane covering called EconoKote®.

Our students now build their own instruments and data collection circuits using Propeller brand microcontrollers made by Parallax. Students at Londonderry High School built and programmed the first microcontrollers to include programmable flight command functions (Figure 4).

We now use the free online program habhub to set our launch location, determine our flight path, and predict our touchdown point. In total, our balloon flights last from 90 to 120 minutes.

Original Research

In the summer program's afternoons, the students work with faculty members and their research groups on projects that are accessible to young people. High school students are particularly adept at pattern recognition. They can examine libraries of plots such as spectrograms and look for events with specific characteristics, extract data and build a database of these events, and then use spreadsheets to process the information.

Recent students have used data from NASA's Advanced Composition Explorer (ACE), Interstellar Boundary Explorer (IBEX), Magnetospheric Multiscale (MMS), Radiation Belt Storm Probes (RBSP), Solar Terrestrial Relations Observatory (STEREO), Wind, and Voyager missions, as well as data from the European Space Agency's Cluster mission. Recent research topics include coronal mass ejections (Figure 5), electromagnetic ion cyclotron waves, magnetic flux ropes, interplanetary shocks, magnetic reconnection, interstellar pickup ions, radiation belt ion injection, and turbulence. Students have tested prototype hardware, built Helmholtz coils for magnetic calibration, and developed booms for instrument deployment on rockets.

Students learn core space science and astrophysics ideas while developing new skills, getting what is often their first insight into careers in science.

Throughout the process, the students not only learn but also get their first look at real science, to everyone's benefit. At the end of the month, the students give poster presentations of their research efforts.

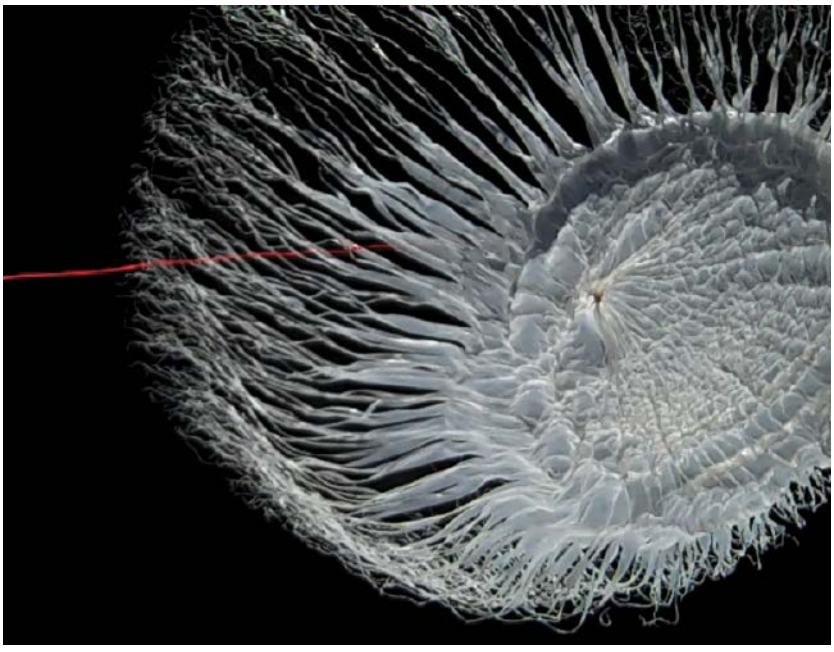
Learning as We Go

A common element in all of the projects has been intense student engagement—students have been involved in the design and building of all of these instruments and the supporting circuits.

Four years ago, on the night of the failed launch, the school board member was right—we do learn from our mistakes: The cutaway hardware we used for that flight was picking up our ham radio transmissions and cutting the payload free prematurely.

The students responded by rerouting cables and adding more shielding and twisted pairs to mitigate radio fre-

Fig. 2. The onboard video camera from the November 2015 flight captured the balloon burst at 30 frames per second. The red line is the cord that ties the payload to the balloon.



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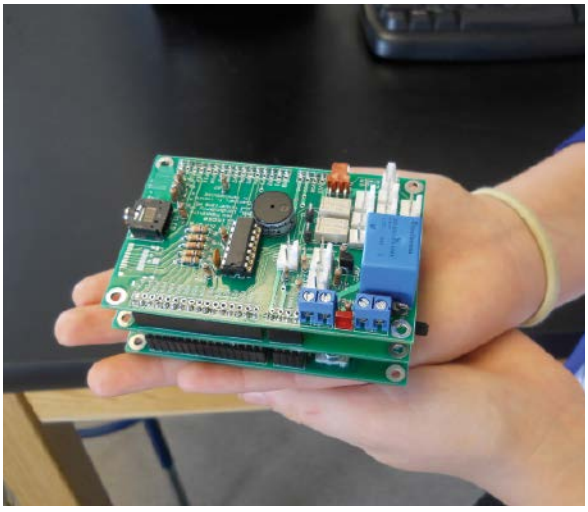
(above) Fig. 3. Film-covered Styrofoam™ payload from the November 2015 launch. Instruments reside in a "hat box" that provides added stiffness to the design.



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(right) Fig. 4. Students at Londonderry High School built and programmed this microcontroller assembly. This is the central processor that we used to command the balloon payload and record instrument data. We have since begun to build and use smaller dedicated data collection units for each instrument, which makes each instrument independent and less reliant upon the success of the others.

quency interference for all electronics. In addition, once the GPS reports that the payload is descending, the autonomous onboard software now sends the same signal to cut away the remains of the balloon so that the payload flies in a more stable configuration.

Our use of sensors continues to evolve. Students now build Sun direction sensors using cadmium sulfide photoresistors and Ping-Pong ball diffusers [*Verhage,* 2010a, 2010b]. They build prototype light-emitting diode–based spectrometer multispectrum light sensors that look at light reflected from Earth [*Mims*, 1992]. We are also considering adding a lightweight dust collector that may be used to collect particulates and high-altitude organic matter in the future. We also have designs for a momentum wheel that will provide greater pointing accuracy to photograph less intense objects such as aurora.

Most recently, the high school team built dedicated electronics that recorded data generated by a gamma ray and energetic neutron detector prototype. This prototype, built by UNH professor Peter Bloser, was successfully flown in November 2015 (Figure 6). High school students are now building more advanced electronics that will provide energy spectra of the cosmic rays they measure.

All this work not only provides students with engineering and mission experience but also helps generate scientific baselines. The successful demonstration of operation in the near-space environment of the balloon flight is quite valuable for future proposals to NASA that will seek to fly similar detector technology on space missions.

A Model for Other Groups

During the failed launch 4 years ago, one of our students—a young woman at Londonderry—was instrumen-

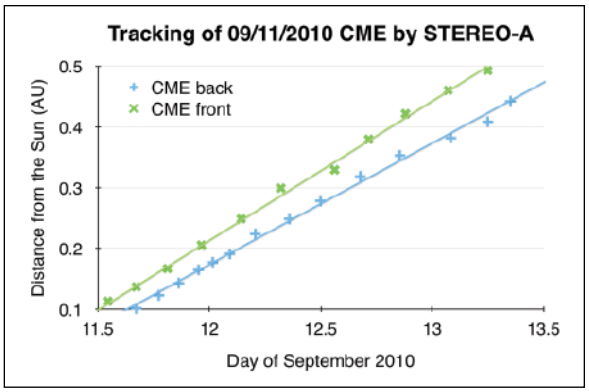

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Fig. 5. Analysis of images of a coronal mass ejection (CME) taken by the heliospheric imagers on board NASA's Solar Terrestrial Relations Observatory (STEREO) spacecraft. In 2014, students Estarlyn Hiraldo and Uri-Jaun Hall, led by Professor Noe Lugaz, plotted the location of the front (leading edge) and back of a CME from 11 September 2010. The plot shows the distance from the Sun in astronomical units (AU) as a function of time. This plot reveals the near-constant motion of the CME and its expansion as the CME front propagates faster than its back.

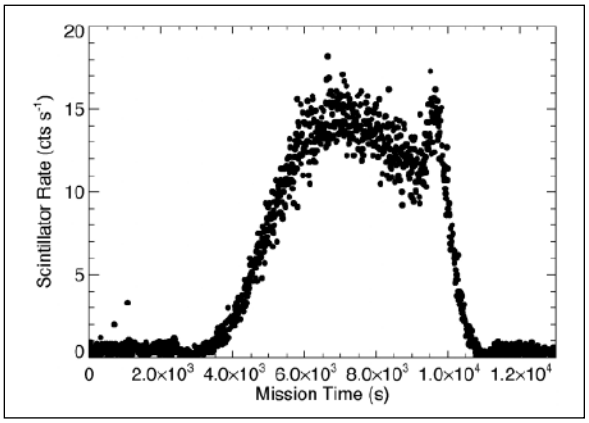

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Fig. 6. Data from the November 2015 flight of the Bloser gamma ray and energetic neutron detector. The Pfotzer maximum, where cosmic radiation produces the greatest concentration of charged particles, was observed at 19 kilometers. The payload flew through this location twice, once going up and the second time coming down, with a maximum flight altitude of 31.5 kilometers. SMART 2015 students Kent Cassidy and Dakotah Stirnweis, assisted by John Gadbois from the SMART 2014 program, built the dedicated electronics for this instrument.

tal in building the flight computer. Her plan was to go into communications after high school.

She is now into her fourth year as an electrical engineering student at UNH and spends her spare time in a lab, building parts for suborbital rockets. We count her as one of our success stories.

We welcome other groups to follow the model for the space science module of Project SMART. We are not the first to use high-altitude ballooning as a tool to engage high school students with different approaches to common problems [*Verhage*, 2015]. The key to our efforts is to have an active faculty who ask more of students than many think possible while engaging the talents and imagination of local high school teachers and creating opportunities for authentic scientific experiences.

We recognize that not every student goes on to a career in science or engineering. Many do, but that is not the only goal of this effort.

We wish to give motivated students the opportunity to learn that the pursuit of knowledge does not begin or end in the classroom. We seek to foster experiences that serve students in their future, whatever their career paths. And, of course, we hope they emerge from the program inclined toward careers in science and engineering.

For more information on UNH's Project SMART space science module, see http://projectsmartspacescience.sr.unh.edu/. To watch videos of the project's balloon launches from 2009 onward, visit our YouTube channel at http://bit.ly/SMARTvideos.

Acknowledgments

We thank the many professors at UNH who regularly contribute to and mentor students in the program.

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Bell to Be AGU President-Elect; Leadership Transition Begins

Members of AGU have elected polar scientist Robin Elizabeth Bell as the organization's next president-elect, as well as 54 other Union officers, Board members, section and focus group officers, and student and early-career representatives to the AGU Council for the 2017–2018 leadership term.

In voting that ended on 27 September, Bell, a professor at Lamont-Doherty Earth Observatory in Palisades, N.Y., was chosen to serve a 2-year term as president-elect starting in 2017, after which she will become AGU president in 2019, the centennial year of the organization. A renowned geophysicist, Bell leads research programs on ice sheets in Antarctica and Greenland, as well as spearheading development of improved technology for imaging beneath the ice from aircraft.

AGU Leadership Transition Begins

Bell and other newly elected leaders will take office on 1 January 2017, and about half of the current AGU Board and Council members will rotate off. New members of the Council Leadership Team will be elected after the first of the year, and committees and task forces will continue their work in support of AGU's mission and the Board and Council work plan.

Planning for 2017–2018 Term

AGU Board and Council members will participate in an evaluation of the 2015–2016 term before the end of this year. This evaluation will provide valuable input to the Governance Committee and staff moving forward and will help shape the orientation of new volunteers in the first quarter of 2017. Current Board, Council, committee, and task force members will be asked to help identify potential volunteers for committees and task forces in the next term.

There are many levels of volunteer opportunities for member participation: sections, focus groups, and Union-level committees and task forces. Time commitment depends on specific roles and responsibilities. Best of all, volunteering for AGU offers a chance to work with other leaders, develop new skills, and make a real difference.

New Officers

The Governance Committee is pleased to announce the newly elected members of the AGU Board and Council. Please join us in congratulating these incoming leaders, who will begin their 2-year terms on 1 January 2017.

AGU Board of Directors
President-elect: Robin Elizabeth Bell
Director, Position 1: Susan K. Avery
Director, Position 2: Chris Ballentine
Director, Position 3: Kerstin Lehnert

Council: Student and Early Career
Student: Tim H. M. van Emmerik
Early Career: Catalina M. Oaida

AGU Sections and Focus Groups

Atmospheric and Space Electricity Focus Group
President-elect: Maribeth Stolzenburg
Secretary: Morris Cohen

Atmospheric Sciences Section
President-elect: James W. Hurrell
Secretary, Composition, Chemistry, Aerosols and Clouds: V. Faye McNeill

Biogeosciences Section
President-elect: Elise Pendall
Secretary: Laura Wasylenki

Cryosphere Focus Group
President-elect: Lora Koenig
Secretary: Sinéad Louise Farrell

Earth and Planetary Surface Processes Focus Group
President-elect: Dorothy Merritts
Secretary: Gregory Hancock

Earth and Space Science Informatics Focus Group
President-elect: Denise J. Hills
Secretary: Anne Wilson

Geodesy Section
President-elect: M. Meghan Miller
Secretary: Brendan Crowell

Geomagnetism, Paleomagnetism and Electromagnetism Section
President-elect: Catherine Johnson
Secretary: France Lagroix

Global Environmental Change Focus Group
President-elect: Philip Mote
Secretary: Ali H. Omar

Hydrology Section
President-elect: Scott W. Tyler
Secretary: Charles H. Luce

Mineral and Rock Physics Focus Group
President-elect: Wenlu Zhu
Secretary: Susannah Dorfman

Natural Hazards Focus Group
President-elect: Seth Stein
Secretary: Daniel Wright

Near-Surface Geophysics Focus Group
President-elect: Xavier Comas
Secretary: Chi Zhang

Nonlinear Geophysics Focus Group
President-elect: Sarah F. Tebbens
Secretary: Jörn Davidsen

Ocean Sciences Section
President-elect: Robert F. Anderson
Secretary, Marine Geochemistry: Claudia Benitez-Nelson
Secretary, Marine Geology and Geophysics: Chuck Nittrouer

Paleoceanography and Paleoclimatology Focus Group
President-elect: Petra Dekens
Secretary: Matthew E. Kirby

Planetary Sciences Section
President-elect: Rosaly M. C. Lopes
Secretary: Michael Mischna

Seismology Section
President-elect: Anne Sheehan
Secretary: Eliza Richardson

Societal Impacts and Policy Sciences Focus Group
President-elect: Maggie Walser
Secretary: Rebecca A. French

Space Physics and Aeronomy Section
President-elect: Christina Cohen
Secretary, Aeronomy: Anthony J. Mannucci
Secretary, Magnetospheric Physics: Elizabeth MacDonald

Study of the Earth's Deep Interior Focus Group
President-elect: Scott D. King
Secretary: Kanani K. M. Lee

Tectonophysics Section
President-elect: Julia K. Morgan
Secretary: Jolante W. van Wijk

Volcanology, Geochemistry, and Petrology Section
President-elect: Michael Manga
Secretary, Geochemistry: Anat Shahar
Secretary, Volcanology and Petrology: Marie Edmonds

Continuing Board

As many new leaders join AGU's governance structure on 1 January, others will continue in their current offices for 2017–2018 or assume new roles according to the succession rules specified in the AGU bylaws.

Current president-elect Eric Davidson will become AGU president and will chair the Board of Directors and the Executive Committee. Current AGU president Margaret Leinen will become past president and serve as chair of the Governance Committee.

AGU established a Board rotation strategy to ensure leadership continuity from term to term. The goal is to carry over about half of the elected positions. Those continuing for 2017–2018 will be President Davidson and Past President Leinen; General Secretary Louise Pellerin; International Secretary Sue Webb; Board members Kelly Klima, Cathy Manduca, and Soroosh Sorooshian; and Executive Director/CEO Chris McEntee. Four additional Board members will be selected by early next year: chair of the Development Board, vice chair of the Council, and two at-large members.

Continuing Council

As incoming president-elect, Robin Bell will chair the AGU Council. A new Council Leadership Team will be elected by Council members after the first of the year to assist her in leading the Council. Davidson and McEntee will remain as Council members to help ensure a smooth leadership transition.

Also continuing on the AGU Council will be early-career representatives Jasmine Crumsey and Aisling Dolan and student representatives Kristie Llera and Annie Tamalavage, together with current section/focus group presidents-elect, who move up to serve as presidents:

Timothy J. Lang, Atmospheric and Space Electricity
Joyce Penner, Atmospheric Sciences
Ariel D. Anbar, Biogeosciences
Tavi Murray, Cryosphere Sciences
William E. Dietrich, Earth and Planetary Surface Processes
Ruth Duerr, Earth and Space Science Informatics
Susan E. Owen, Geodesy
Laurie L. Brown, Geomagnetism, Paleomagnetism and Electromagnetism
Ellen Mosley-Thompson, Global Environmental Change
Jeffrey McDonnell, Hydrology
Andrew Campbell, Mineral and Rock Physics
Ramesh P. Singh, Natural Hazards
Sarah Kruse, Near-Surface Geophysics
Annick Pouquet, Nonlinear Geophysics
Eileen Hofmann, Ocean Sciences
Figen Mekik, Paleoceanography and Paleoclimatology
Sarah T. Stewart, Planetary Sciences
Douglas Wiens, Seismology
Linda R. Rowen, Societal Impacts and Policy Sciences
Larry J. Paxton, Space Physics and Aeronomy
Allen K. McNamara, Study of the Earth's Deep Interior
Ross Stein, Tectonophysics
William F. McDonough, Volcanology, Geochemistry, and Petrology

This is a great time to be involved in AGU. Topics continuing on the Board and Council work plan include preparing for AGU's centennial celebration, designing new ways for members and other stakeholders to engage with one another and AGU, implementing the meetings strategic plan, leading discussions on sexual harassment, making progress toward AGU's talent pool goal, furthering AGU leadership in data science, and advancing scholarly publishing.

Members who volunteer can make a real difference. It is rewarding work to advance AGU's mission and vision in collaboration with colleagues from around the world.

By **Carol Finn,** AGU Past President and Governance Committee Chair; email: AGU_Governance@agu.org

2016 AGU Election Statistics

AGU's Governance Committee summarizes below this year's election process—including voting procedures, participation, and communications—and compares the 2016 election with prior AGU elections.

Electronic Voting

Members voted electronically, and access to voting was provided to eligible voters for a period of 30 days. All members who joined or renewed their membership by 1 August 2016 were eligible to vote in this year's leadership election.

Survey and Ballot Systems, Inc. (SBS) conducted the voting. SBS, which offers election planning and management services, provided unique log-in links and other support services for eligible voters throughout the election. On 29 September, the company certified the results, which were then reviewed by the AGU Governance Committee the next day.

Participation Rate Tops 21%

The total number of ballots validated in the election was 9517. The number of eligible voters was 45,037, making the participation rate 21.13%. This is almost 5% higher than AGU's last election, in 2014.

SBS provided all voters the opportunity to rate their satisfaction with the 2016 voting process. In response to this election, 5864 comments were received—more than 9 times the 647 comments received in 2014 and greater than double the previous record response of 2619 comments in 2012.

This is a good indication of voter engagement, and 91.1% of voters continue to be satisfied or very satisfied with the voting process. Voters provided many comments and suggestions, which AGU analyzed and discussed in the ensuing weeks. Voter feedback is very important, and comments received in 2014 were instrumental in helping the Governance Committee plan for the 2016 election.

Getting the Word Out

The election was supported by communication throughout this year. The Governance Committee published the proposed slate of candidates on Eos.org on 10 May and the final slate, on 18 July. Details about the election were also communicated through two biweekly AGU electronic newsletters: *AGUniverse,* distributed to all AGU members, and the *Meetings Newsletter,* sent to all past Fall Meeting attendees.

A special elections website, including frequently asked questions, was created to aid members with the voting process. Promotion of the election included the AGU home page carousel, *Eos* print ads, *Eos Buzz* ads, Facebook, Twitter, and emails. The election vendor sent reminder emails to eligible voters throughout the election, as did section and focus group leaders.

Notifications

After reviewing the election report provided by SBS, the Governance Committee kicked off the process to notify candidates and announce the results. The process required that all 110 candidates be notified before the election results could be publicly announced. Each of the 23 sections and focus groups provided a single point of contact to receive results and contact candidates. Governance Committee members contacted Board candidates and the student and early-career candidates. Results were released online on 11 October 2016.

The Governance Committee expresses its gratitude to all candidates and to all AGU members who voted in this very important election.

—Governance Committee: Carol Finn (Chair); email: AGU_Governance@agu.org; Julie Brigham-Grette, Mary Anne Carroll, Hans Lechner, Catherine McCammon, Holm Tiessen, George Tsoflias, Chris McEntee, and Cheryl Enderlein

Hong Kong, Macau at Greater Tsunami Risk Than Thought

danielvfung

A new study of tsunami risk in the South China Sea highlights risk to major Asian cities, including Hong Kong.

When two tectonic plates move past each other along fault lines deep within the Earth, the rupture is often felt as an earthquake at the surface. If the quake happens below water, such a rupture can also cause a tsunami. The complexity of ruptures—variations in the direction of motion and length of displacement along the fault, known as heterogeneous slip—can, in turn, affect the size of an ensuing tsunami and the extent of damage that it can cause in coastal communities.

However, current methods that scientists and policy makers use to assess tsunami hazard do not account for rupture complexity. The problem is that the more complex a slip is, the higher the computational load is for a prediction model. Here *Li et al.* examine how heterogeneous slips can affect tsunami risk in the South China Sea.

To understand the contribution of complex slips to tsunami risk, the researchers modeled earthquakes with a wide range of magnitudes originating from a megathrust—a subduction zone where one tectonic plate is being forced underneath another. They focused on the megathrust along the Manila Trench in the South China Sea.

Using a Monte Carlo probabilistic tsunami hazard assessment (PTHA), the authors calculated the height of potential tsunamis generated from an earthquake source. In the assessment, the scientists subdivided the area of the fault zone into discrete regions to account for the effects of complex slip along the rupture. The team also compared the projected risks of the tsunami resulting from a complex slip to a more uniform, homogeneous rupture.

The complex and uniform models for earthquakes with shorter return periods tend to converge on the same result. But the study revealed that if the subduction zone in the Manila Trench generated a massive tsunami-producing earthquake, nearby regions like southern Taiwan and the Philippines' western Luzon Island would likely face the greatest tsunami hazard in the South China Sea.

Of considerable note is the finding that more complex slips—tsunami-producing earthquakes big enough to happen only once every 500 years—can lead to bigger tsunami waves in heavily populated southern China. These waves are 20%–60% larger than waves produced by more uniform slip models.

In other words, the complex model showed an average wave height increase of roughly 0.5 meter across the region for tsunamis with a 500-year return period. Thus, areas like Hong Kong and Macau are at greater risk from tsunami inundation than previously thought.

The authors note that because current models do not account for the heterogeneity of slips, they may be significantly underestimating tsunami risk in vulnerable areas. They recommend that tsunami-prone coastlines close to large subduction zones should account for slip complexity in their tsunami prediction models. (*Journal of Geophysical Research: Solid Earth*, doi:10.1002/2016JB013111, 2016) **—Wudan Yan, Freelance Writer**

Volcanic Ash Contributes to Climate Cooling

D.T. Fairlie, NASA

Preparation of the large balloon flight with aerosol payloads conducted during the KlAsh campaign on 20 May 2014 from Corroboree (Northern Territory, Australia).

Volcanic eruptions are known to cause changes in atmospheric temperature. Eruptions eject large amounts of fine ash and sulfur dioxide, which transform into sulfate aerosols—extremely small airborne particles—into the atmosphere. Those tiny sulfate particles reflect solar radiation back into space, preventing the radiation from heating Earth's atmosphere below.

Most climate models incorporate this aerosol effect into the calculations used to predict future climate trends. Although sulfates are known to linger in the atmosphere for months or years, researchers previously assumed that ash particles fall from the sky soon after an eruption and therefore don't contribute to cooling.

However, recent discrepancies in climate model predictions and actual global temperatures have led scientists to wonder whether ash plays a larger role in cooling the atmosphere. Here *Vernier et al.* investigated whether fine ash particles could be reflecting solar radiation long after an eruption.

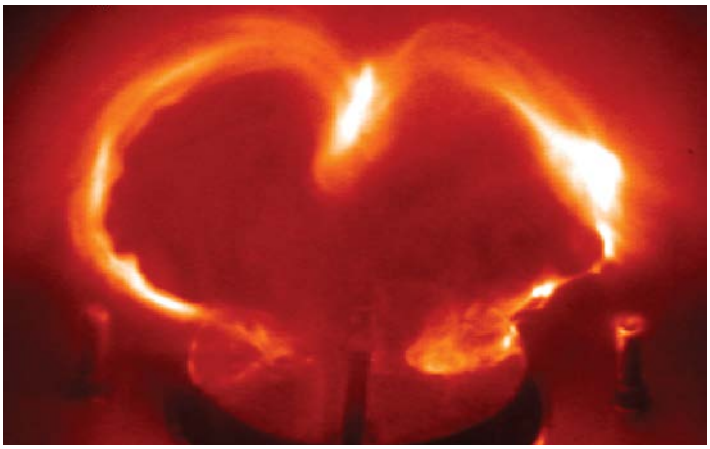
The authors studied the ash in the atmosphere following the Mount Kelud eruption in Java, Indonesia, on 14 February 2014. On that day, Kelud erupted for a few hours, spewing volcanic material into the stratosphere.

Following the eruption, the researchers tracked the Kelud plume using instruments aboard the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) satellite that measure backscatter, which hints at the shape and size of the particles within the plume and allowed the team to distinguish between ash and sulfate particles. Three months after the eruption, the researchers also launched the Kelud Ash (KlAsh) balloon field campaign from Darwin, Australia, to measure the reflectivity and size of ash and sulfate particles that remained in the Kelud plume. The team released five small sondes, or balloon instruments, and one large one over the course of 10 days.

They discovered that ash particles persisted within the plume months after the eruption, accounting for 20%–25% of the plume's aerosol optical depth, a term that describes the amount of sunlight atmospheric particles can block. The satellite observations also revealed that the ash particles were more prevalent in the lower layer of the volcanic cloud, while sulfate aerosols were generally observed at higher altitudes.

The scientists suggest that fine ash particles from tropical eruptions can remain suspended for longer periods because there is more atmospheric circulation keeping them afloat. The ash from this and other eruptions over the past decade has likely contributed to regulating the global climate, which might partially explain why climate models did not accurately predict current climate temperatures. The findings could help improve the accuracy of climate predictions in the future. (*Journal of Geophysical Research: Atmospheres,* doi:10.1002/2016JD025344, 2016) **—Alexandra Branscombe, Freelance Writer**

Lab Experiment Tests What Triggers Massive Solar Eruptions



J. F. Hansen and P. M. Bellan/Caltech

Scientists successfully reproduce coronal mass ejections in their laboratory. The distance between the plasma foot points is 8 centimeters.

Coronal mass ejections (CMEs) are huge explosions of plasma from the Sun that race toward Earth in a matter of hours and can cause serious harm to satellites, astronauts, and power grids. For years, scientists have debated over which physical processes could possibly trigger CMEs. Now *Ha and Bellan* provide experimental support for one such mechanism.

CMEs are associated with large magnetic field structures called flux ropes that extend outward from the Sun in twisted filaments of plasma. Recent observations suggest that a CME is triggered when a preexisting flux rope suddenly loses stability, causing a plasma eruption. The authors set out to test one proposed mechanism for this loss of stability known as the torus instability.

The torus instability is thought to occur in the Sun's upper atmosphere, the corona, when the growth of a flux rope is held back by a strapping magnetic field structure that decays with increasing altitude. At a critical altitude, the strapping field is too weak to hold back the flux rope, which then breaks loose and accelerates rapidly, releasing energy in the form of a CME.

It is difficult to measure or model magnetic fields in the corona, so the scientists had to figure out another way to test whether the torus instability could trigger CMEs. The pair decided to create their own flux ropes in the lab. They used a plasma gun and an artificial strapping field to set off CME-like eruptions inside a vacuum chamber.

Using a carefully designed strapping field that decayed as a precise function of height, the scientists were able to create plasma eruptions that mimicked observed CME behavior. CMEs are known to begin with a slow-rise phase that eventually gives way to rapid acceleration; the experimental CMEs followed that pattern, supporting the torus instability hypothesis.

This study marks the first time that scientists have successfully demonstrated the transition from slow rise to rapid acceleration in the lab. These results and similar experiments in the future could improve predictions of potentially destructive CMEs. (*Geophysical Research Letters,* doi:10.1002/2016GL069744, 2016) **—Sarah Stanley, Freelance Writer**

A Better Model for How the Mantle Melts

The bulk of the Earth's volume is composed of the mantle—the layer of silicate rocks sandwiched between the dense, hot core and the thin crust. Although the mantle is mostly solid rock, it's generally viscous: Slowly, over millions of years, the material within the layer drifts, driving tectonic plates together and apart. Thus, the mantle's influence can be seen on the planet's surface on both large and small scales—from fueling volcanoes and seafloor expansion down to the composition and characteristics of igneous rocks.

Most of the Earth's mantle is composed of peridotite, an igneous rock rich in the mineral olivine. But previous research suggests that melted mantle pyroxenites—igneous rocks composed primarily of pyroxenes, minerals that contain 40% more silicon than olivine—may also be a source of oceanic lavas. New research by *Lambart et al.* seeks to better model how pyroxenites influence melting that occurs in the mantle.

Pyroxenites make up between 2% and 10% of the upper mantle, depending on the region, but determining the amount of pyroxenites in hot mantle plumes that reach the surface requires more information. Researchers have found that at the same pressure, pyroxenites tend to melt at lower temperatures than peridotites, which means that any pyroxenites in peridotite-rich mantle regions might make up a larger portion of the liquid material than their small fraction of mantle bulk would suggest.

To understand how the varying source materials in the mantle contribute to the characteristics of igneous rocks at the surface, researchers need to understand the melting characteristics of pyroxenites—a broad and variable group of rocks. That variability in composition makes predicting the phase changes of pyroxenites more complicated. And that complexity means that current models of mantle melting, like pMELTS, overestimate the temperature range over which pyroxenites melt. So the authors created a new parameterization for mantle melting models that seeks to rectify the problem.

The new parameterization accounts for the fact that temperature, pressure, and the bulk chemical composition of the rocks together determine their near-solidus temperature. The authors used a compilation of 183 experiments on pyroxenites with 25 varying chemical compositions, carried out over pressures from 0.9 to 5 gigapascals (GPa) and temperatures ranging from 1150°C to 1675°C. They charted the temperature when 5% of the materials was molten and the temperature at which clinopyroxene, a dominant mineral in pyroxenites, in each sample was gone—parameters that are easy to detect accurately and consistently.

Sarah Lambart

Piece of the Earth mantle exposed at the surface in the massif of Beni Bousera, Morocco, showing layers of pyroxenites (in gray) and peridotite (in brown).

This analysis helped the authors create a new model based on experimental data from the literature, dubbed Melt-PX, which predicts the temperature at which the pyroxenites start to melt within 30°C and the amount of melting within 13%. It showed that at low pressure—less than 1 GPa—pyroxenites melt at lower temperatures than peridotites, but as pressure increases, more and more pyroxenites melt at higher temperatures than peridotites.

The new model will be a useful tool to understand magma composition, ultimately giving researchers a window into the Earth and the source of oceanic basalts. (*Journal of Geophysical Research: Solid Earth,* doi:10.1002/2015JB012762, 2016) **—Kate Wheeling, Freelance Writer**

Mapping Water and Heat Deep Under Long Valley Caldera

Long Valley Caldera is a volcanic depression near Mammoth Mountain in California, which has experienced extensive hydrothermal activity over two periods of time since it formed about 767,000 years ago. The caldera is home to an active hydrothermal system, which has been extensively studied close to the surface but less well characterized deeper underground. Hot fluids flow underground and escape to the surface through hot springs, but the heat source and reservoir for the labyrinthine hydrothermal system have not been thoroughly studied.

Now *Peacock et al.* have used magnetotellurics to create a three-dimensional (3-D) model of the ground down to 10 kilometers underneath the Long Valley volcanic system. To create this 3-D model, the team measured the Earth's electrical response to natural magnetic fields at 61 stations across Long Valley Caldera.

From those measurements, the researchers produced a model of the ground's electrical resistivity. Because geothermal systems like the one in Long Valley Caldera consist mainly of electrically conductive fluids and clays, the researchers used the contrast between those hydrothermal characteristics and the surrounding resistive host rocks to study five conductive zones under the caldera.

In studying the conductive zones, the team found several separate zones of fluids and areas of partial melt. One of the zones of fluids—located 4 kilometers below Deer Mountain—is interpreted as the reservoir for the hydrothermal system. Moreover, the heat source could be an area of partial melt at 8 kilometers in depth, although the authors explain that other plausible heat sources could exist.

The researchers also discovered two additional bodies of aqueous fluids, one beneath a valley within the caldera that's bound by faults (graben) and one under Mammoth Mountain. Both aqueous fluid bodies could originate from zones of partial melt 8 kilometers below the surface.

Jared Peacock

The view northeast from Mammoth Mountain in California. Just to the right of the bald area near the middle of the picture is Deer Mountain, where the reservoir for the hydrothermal system is. The caldera rim is visible in the background, where the flat area meets the mountains.

These conclusions agree with past studies of the shallow part of the system, and future work will combine the new study's findings with fluid flow modeling to confirm that researchers' interpretations of Long Valley Caldera's hydrothermal system are valid. (*Geophysical Research Letters,* doi:10.1002/2016GL069263, 2016) **—Leah Crane, Freelance Writer**

Can We Predict the Future of Ocean Carbon Dioxide Uptake?

Since 1765, the ocean has soaked up a sizeable chunk—approximately 30%—of the excess carbon dioxide released into the atmosphere by human activity. As such, modeling future climate change requires that researchers accurately understand carbon dioxide uptake by the ocean. However, climate projections from current simulations are often hindered by uncertainty stemming from unknowns in future climate variability and emissions and the inherent limitations of modeling the physical world.

To get a handle on just how much uncertainty is present in climate projections, researchers often run multiple simulations with the same external forcing acting on various initial atmospheric inputs. These large ensembles of simulation are common for atmospheric projections but have been used less frequently to make predictions about the state of the ocean.

Here *Lovenduski et al.* present a new analysis of ocean carbon dioxide uptake from ensembles of Community Earth System Model simulations, which allowed the researchers to account for uncertainty arising from differing emissions scenarios or climate variability. For climate variability, the authors considered natural cycles like the El Niño–Southern Oscillation, which have the potential to dampen or amplify trends in ocean uptake. To account for uncertainty due to the model structure, the team looked at simulations from the fifth phase of the Coupled Model Intercomparison Project. They covered much of the globe and 17 distinct biogeographical biomes.

On global scales, future changes in the exchange of carbon from the air to the sea are dominated by uncertainties in the emissions themselves; emissions depend on complex changes in society and technology, which are naturally hard to predict. Uncertainties in internal variability disappear within a lead time of a decade or so, and model uncertainties disappear after the first few decades, leaving the emissions uncertainties to dominate in the long run. On regional scales, however, future changes are dominated by internal variability and model structure.

The authors suggest that scientists invest their resources in improving model structural uncertainty for two reasons: Improving upon model structure will be easier than guessing what future emissions will look like or than better understanding the climate system's natural variability. It will greatly reduce the uncertainty on a regional scale. (*Global Biogeochemical Cycles,* doi:10.1002/2016GB005426, 2016) **—Shannon Hall, Freelance Writer**

ATMOSPHERIC SCIENCES

Assistant Professor

Assistant Professor with focus on Atmospheric Sciences. The College of Earth, Ocean, and Atmospheric Sciences at Oregon State University located in Corvallis, Oregon invites applications for a full-time (1.0 FTE) 9-month or part-time (0.75 FTE) 12 month tenure-track position. We seek an atmospheric science faculty member who will teach and mentor undergraduate and graduate students; develop and maintain a vigorous, externally funded research program; and collaborate with colleagues. We have a new degree option in climate science and are expanding our undergraduate and graduate courses with emphasis on experiential learning and multidisciplinary sciences. The position will take a leading role in furthering both the educational mission and research portfolio within the growing climate science program. Requires: Ph.D. in atmospheric science, oceanography, or a closely related field by the start of employment. Demonstrated ability or potential: for teaching excellence and commitment to student success; to develop and teach courses in climate science, basic meteorology, or atmospheric physics at an undergraduate level; for mentoring undergraduate students, graduate students and post-doctoral scholars; and commitment to educational equity. Scholarly potential demonstrated by a record of peer-reviewed publications and a clearly defined research agenda commensurate with academic rank. For college information see: http://ceoas.oregonstate.edu. To apply submit CV, letter of interest, and statements online at https://jobs.oregonstate.edu/postings/33732 For full consideration, apply by 11/28/2016. Closing date: 01/09/2017.

Faculty Position in the Department of Climate and Space Sciences and Engineering at the University of Michigan

The Department of Climate and Space Sciences and Engineering in the College of Engineering at the University of Michigan in Ann Arbor invites applications for a tenured or tenure-track faculty position. Applicants at all ranks will be considered. We welcome applicants working on tropical meteorology, extreme weather, data assimilation and the weather–climate continuum, as well as applicants working at the interface between engineering and science applications. Applicants whose research emphasizes instrumentation, field observations, large-scale computing or big data analysis are all welcomed to apply. Exceptional applicants in other areas of the atmospheric sciences will also be considered.

The successful candidate is expected to (1) develop a widely recognized and externally funded research program,

Tenure-Track Assistant Professor: Geodesy
California State University Northridge

The Department of Geological Sciences at California State University, Northridge invites applications for a full-time tenure-track faculty position at the level of Assistant Professor in geodesy to study surface and/or subsurface Earth processes. We offer B.S., and M.S., degrees in Geology and in Geophysics. We seek an innovative geodesist with technical expertise in GPS, InSAR, LiDAR, radar altimetry, gravimetry or other geodetic methods. Candidates with research that complements our current research program are encouraged including but not limited to surface processes, sedimentology, geomorphology, climate, coseismic and interseismic fault physics, marine geology and geophysics, planetary geophysics, and crust and mantle scale tectonics. The successful candidate is expected to develop a vigorous research program, which includes obtaining extramural funding, publishing peer-reviewed papers, and involving B.S. and M.S. students. The successful candidate is also expected to demonstrate teaching excellence and provide effective instruction to students of diverse backgrounds in a multicultural setting. Potential classes to be taught by the new hire include an undergraduate core course in Earth Systems or Plate Tectonics and Structure, general education courses, and elective offerings at the upper-division and/or graduate level in the candidate's research specialty. The successful candidate must have a Ph.D. at the time of appointment. Experience in post-doctoral research and/or University-level lecture instruction is desirable. Applicants should submit a statement of research interests, a statement of teaching philosophy and experience, a cover letter, CV, and the names and full contact information for three references,. Electronic submissions are strongly encouraged and should be sent to: geodesy@csun.edu. Materials can also be sent to: Geodesy Search Committee, Department of Geological Sciences, California State University Northridge, 18111 Nordhoff Street, Northridge, CA 91330-8266. Review of applications will begin January 5, 2016. Priority will be given to applications received by this date, but the position remains open until filled. For additional information, see http://www.csun.edu/geology. The University is an EO/AA employer.

(2) supervise graduate students in research and (3) participate in the teaching mission of the Department and the College at both the graduate and undergraduate levels. Interest in developing collaborative relationships in research and teaching with other departments and colleges in the University is strongly encouraged. A PhD in a subject related to climate sciences or other relevant disciplines in science or engineering is required. Applications should include a cover letter, CV, research and teaching statements, and a list of at least four references. For full consideration applications in a single PDF file should be received before December 8th, 2016. Applications and questions concerning this position should be directed to claspsearch@umich.edu or the search committee chair Prof. Xianglei Huang (xianglei@umich.edu).

Formerly known as the Department of Atmospheric, Oceanic, and Space Sciences, the department changed to the current name in 2015 in order to better communicate the broad scope and depth of research, teaching and service in the department and to emphasize its connection to the College of Engineering. The department currently consists of 27 tenured or tenure-track faculty and 125 graduate students with annual research expenditures of $52.2 million in 2016. It offers an exciting research and teaching environment with wide scope and rich expertise within the Department as well as diversified interdisciplinary opportunities within the University. A recent highlight from the department is the incoming launch of the first NASA Earth-Venture Mission, CYGNSS (Cyclone Global Navigation Satellite System), which is led by our faculty member and aims to improve extreme weather prediction. Research conducted within the Department covers radiation and climate, remote sensing, atmospheric dynamics and numerical methods, carbon cycle science, atmospheric chemistry and air pollution, aerosol-cloud-climate interactions, as well as mesosphere-to-ionosphere coupling, heliophysics, space weather, and planetary science. Strong expertise exists in instrumentation, numerical simulations, as well as theoretical studies. In addition to the regular PhD program, the department also offers Master of Engineering programs in Applied Climate and Space Engineering.

The University of Michigan in Ann Arbor has 19 schools and colleges in total. CLaSP faculty have ongoing collaborations with researchers and fac-

Ocean Prediction Postdoctoral Positions Naval Research Laboratory, Stennis Space Center, MS

U.S. NAVAL RESEARCH LABORATORY

The Naval Research Laboratory is seeking postdoctoral researchers to push forward the frontiers of ocean forecasting. The work covers a wide scope of physics including surface waves, thermohaline circulation, nearshore circulation, and ocean/atmosphere coupling from global to nearshore scales. This challenging work includes processing and analysis of satellite and in water observations, construction of numerical model systems on high performance computing systems and assimilation for predicting the ocean environment. For a quick overview of some of the research work within the NRL oceanography division at Stennis Space Center, visit the web site:
https://www7320.nrlssc.navy.mil/pubs.php

Applicants must be a US citizen or permanent resident at time of application. Applications will be accepted until positions are filled. Please e-mail a resume and description of research interests:

Gregg Jacobs: gregg.jacobs@nrlssc.navy.mil

Fellowships for Postdoctoral Scholars at

Woods Hole Oceanographic Institution

Scholarships are available to new or recent doctoral graduates in diverse areas of research. Applications will be accepted from doctoral recipients with research interests associated with the following:

Departments - Applicants who wish to conduct research on topics of general interest to one or more of the departments are encouraged to apply. The Departments are:

- **Applied Ocean Physics & Engineering**
- **Biology**
- **Geology & Geophysics**
- **Marine Chemistry & Geochemistry**
- **Physical Oceanography**

Institutes - With the aim of fostering interdisciplinary research addressing critical issues, WHOI has established four institutes. We anticipate that we will award a scholarship to support research within the Institutes. The Institutes are:

- **Ocean and Climate Change Institute**
- **Ocean Exploration Institute**
- **Coastal Ocean Institute**
- **Ocean Life Institute**

A joint USGS/WHOI award will be given to a postdoc whose research is in an area of common interest between USGS and WHOI Scientific Staff. The individual will interact with both USGS and WHOI based advisors on their research.

The National Ocean Sciences Accelerator Mass Spectrometry Facility (NOSAMS) will award a fellowship in the development and implementation of new techniques in marine science radiocarbon studies.

Recipients of awards are selected competitively, with primary emphasis placed on research promise. Scholarships are awarded for 18-month appointments with a stipend of $58,500 per year, a modest research budget and eligibility for group health and dental insurance. Recipients are encouraged to pursue their own research interest in association with resident Scientific and Senior Technical Staff. Communication with potential WHOI advisors prior to submitting an application is encouraged. Completed applications must be received by January 5, 2017 for the 2017/2018 appointments. Awards will be announced by March.

Further information about the Scholarships and application forms as well as links to the individual Departments and Institutes and their research themes may be obtained through the Academic Programs section of the WHOI web pages at:

www.whoi.edu/postdoctoral

An Equal Opportunity/Affirmative Action Employer

WOODS HOLE OCEANOGRAPHIC INSTITUTION 1930

ulty in many other nationally top-ranked programs within the University, including other engineering departments, the School of Natural Resources and the Environment, Earth and Environmental Sciences, the School of Public Health, School of Information, and the Ross School of Business.

The College is especially interested in qualified candidates who can contribute, through their research, teaching, and service, to the diversity and excellence of the academic community. Women, minorities, individuals with disabilities, and veterans are encouraged to apply. The University is also responsive to the needs of dual career couples. The University is a nondiscriminatory, affirmative action Employer.

Open-rank faculty position in Atmospheric & Oceanic Observations, University of Colorado, Boulder

The Department of Atmospheric and Oceanic Sciences (ATOC) at the University of Colorado, Boulder, invites applications for an open-rank faculty position for a person who plays a prominent role in the field of atmosphere, ocean, or cryosphere observations. Areas of interest include airborne, satellite and ground-based remote sensing, in situ observations, and land- and ocean-networks. The work should have broad applications to climate and weather, and should complement existing strengths within ATOC. This person should have a PhD in Atmospheric Science, Oceanography, or a related field, with a record of research and teaching excellence that meets the standards expected for appointment at an R1 doctoral university. Review of applications will begin 5 January 2017, and will continue until the position is filled. Informal inquiries can be made to Peter Pilewskie at peter.pilewskie@lasp.colorado.edu.

The University of Colorado is an Equal Opportunity/Affirmative Action employer. Applications are accepted electronically at https://cu.taleo.net/careersection/2/jobdetail.ftl?job=06673&lan.

GEOCHEMISTRY

ASSISTANT PROFESSOR IN ORGANIC GEOCHEMISTRY

The University of Oklahoma invites applications for a tenure-track position in organic geochemistry at the level of Assistant Professor. The ConocoPhillips School of Geology and Geophysics has a distinguished history in organic geochemistry. We seek an individual who will complement our existing strengths in the geochemical study of organic matter, and who will help us move forward into new and exciting areas of research. The successful candidate must show potential to be an effective teacher who will contribute to our core undergraduate curriculum as well as offer advanced classes in the discipline. The successful applicant will hold a Ph.D. at the time of application, develop an externally funded research program, and sponsor and train graduate students at the Masters and Doctoral levels.

The ConocoPhillips School of Geology and Geophysics is housed in the Sarkeys Energy Center. Our research facilities, which are detailed at http://www.ou.edu/content/mcee/geology/Research.html, include extensive laboratory capabilities in mass spectrometry of carbon compounds and bulk and compound-specific stable isotopic analysis. As the chemistry of carbon figures prominently in research campus-wide, this position in organic geochemistry fills a prominent role with many avenues for collaboration with faculty within and outside of the School.

Review of applications will begin January 1, 2017. The search will continue until the position is filled. The anticipated start date for the position is Fall semester 2017. Applicants can apply online at http://apply.interfolio.com/38699. Applicants will be required to submit a vita/resume, statement of plans for sponsored research, teaching interests, and a list of five references who can be contacted, including telephone numbers, e-mail addresses, and mailing addresses. Questions or information requests should be addressed to the Chair of the Organic Geochemistry Search Committee, at (405) 325-3253 or ougeochemistrysearchchair@ou.edu.

The University of Oklahoma (OU) is a Carnegie-R1 comprehensive public research university known for excellence in teaching, research, and community engagement. In 2014, OU became the first public institution ever to rank #1 nationally in the recruitment of National Merit Scholars, with 311 scholars. The 277-acre Research Campus in Norman was named the No.1 research campus in the nation by the Association of Research Parks in 2013. Norman is a culturally rich and vibrant town located just outside Oklahoma City. With outstanding schools, amenities, and a low cost of living, Norman is a perennial contender on the "Best Places to Live" rankings. Visit http://soonerway.ou.edu for more information.

The University of Oklahoma is an Affirmative Action, Equal Opportunity Employer. Individuals from underrepresented groups are encouraged to apply.

Curator in Earth and Planetary Science, American Museum of Natural History

The Division of Physical Sciences of AMNH seeks to hire a tenure-track assistant curator in the Department of Earth and Planetary Sciences. We seek candidates who will bring petrological and geochemical methods to bear on problems related to planetary evolution. For example, candidates might integrate field, analytical, and theoretical studies of the rock record to provide insights into fundamental aspects of climate, environmental, and biogeochemical variability through time. The successful candidate will have demonstrated scientific creativity and the potential to build and sustain an innovative research program. They will be expected to take advantage of resources available at AMNH, which include world-class geological collections; a wide range of optical, electron beam, and x-ray analytical tools; experimental laboratories; LA-ICPMS facilities shared with Lamont Doherty Earth Observatory of Columbia University; and a program supporting scientific expeditions. They will oversee and expand the AMNH petrology collection. We welcome an intention and ability to collaborate with colleagues within AMNH and the regional community, including Columbia University and CUNY, and to engage in AMNH's MA in Teaching of Earth Science and other education initiatives. Applications should include a cover letter; CV; research statement; statement addressing teaching, exhibition, and public outreach; PDFs of up to 5 publications; and three letters of reference. All materials should be submitted by December 16, 2016 to EPSsearch@amnh.org. Inquiries about the position should be directed to Denton Ebel (debel@amnh.org). The American Museum of Natural History is an EEO/AA Employer.

GLOBAL ENVIRONMENTAL CHANGE

FACULTY POSITION IN CLIMATE CHANGE AND SUSTAINABILITY, University of California, Riverside

The Department of Earth Sciences at UCR is recruiting a faculty member in

the broadly defined area of Climate Change and Sustainability. This is an academic year tenure track position at the Assistant Professor level and will be available July 1, 2017.

We seek to hire a faculty member in Climate Change and Sustainability, working at broad spatial scales over human-relevant time scales, and with expertise in one or more of the following fields: climate dynamics, land or ocean surface processes, and ocean/atmosphere interactions. The candidate is expected to use state-of-the-art models and observations as the foundation of their research and to work at regional to global scales. A Ph.D. in atmospheric science, environmental science, oceanography, or a related science discipline is required. Applications must include a cover letter, curriculum vita, statements of research and teaching interests, a statement of contributions to diversity, and three letters of recommendation. All application materials must be submitted through AP Recruit at: https://aprecruit.ucr.edu/apply/JPF00678. Advancement through the faculty ranks at the University of California is through a series of structured, merit-based evaluations, occurring every 2–3 years, each of which includes substantial peer input.

For more information about the position, please contact Dr. Robert Allen, Department of Earth Sciences, at robert.allen@ucr.edu. Review of applications will begin on January 9, 2017, and will continue until the position is filled. Additional information about the Department of Earth Sciences can be found at: http://earthsciences.ucr.edu/.

UCR is a world-class research university with an exceptionally diverse undergraduate student body. Its mission is explicitly linked to providing routes to educational success for underrepresented and first-generation college students. A commitment to this mission is a preferred qualification.

The University of California is an Equal Opportunity/Affirmative Action Employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, age, disability, protected veteran status, or any other characteristic protected by law.

The Foster and Coco Stanback Postdoctoral Fellowship in Global Environmental Science

The California Institute of Technology invites applications for a postdoctoral fellowship in global environmental science beginning in the fall of 2017. The intent of the program is to support innovative and creative early career scientists working in global environmental science, including areas such as biogeochemistry, glaciology, paleo-climatology, and the atmosphere and ocean sciences.

The fellowship is funded in part by an endowment provided by Foster and Coco Stanback. It carries an annual stipend of $62,000 plus a research expense fund of $5,000 and one-way travel costs to Pasadena. The duration of each appointment is normally two years, contingent upon completion of the Ph.D. degree and good progress in the first year. The Stanback Fellow will be hosted by one or more professors, who will also provide financial support in the second year. Fellows are eligible to participate in Caltech's benefit programs, including health and dental plans.

To apply online, please go here: https://applications.caltech.edu/job/stanback

Materials in support of an application should include curriculum vitae, list of publications, a one-page statement of research interests, and three letters of reference. To be eligible, candidates should have received their Ph.D. no earlier than April 1st, 2016 except in exceptional circumstances. All applications and references are due by January 31, 2017.

Fellowship candidates will automatically be considered for other available postdoctoral positions at Caltech in their fields of interest.

If there are any questions during the application process, please contact Jen Shechet at shechet@gps.caltech.edu

HYDROLOGY

Assistant Professor, University of North Dakota

The Harold Hamm School of Geology and Geological Engineering in the University of North Dakota's College of Engineering and Mines invites applications for a tenure-track faculty position in geological engineering at the assistant professor level. We seek an outstanding candidate in the field of hydrogeology who will develop or maintain a dynamic research program that will attract and support graduate students through external grant funding. Teaching responsibilities will include classes in hydrogeology, snow hydrology, and groundwater with other undergraduate and graduate geological engineering courses in the candidate's area of expertise. Applicants must have an undergraduate degree in engineering (geological preferred) and hold a Ph.D. in geological engineering, engineering geology, or a closely related science or engineering field. The successful candidate will be expected to (1) develop a strong external funded research program, (2) contribute to the School's graduate and undergraduate programs through teaching, and (3) provide service to help the faculty and administration attain School, College of Engineering and Mines, and University goals, and (4) direct activities in the School's Environmental Analytical Research Laboratory (EARL).

TEXAS TECH UNIVERSITY
ATMOSPHERIC SCIENCE GROUP
DEPARTMENT OF GEOSCIENCES
TENURE-TRACK POSITION ANNOUNCEMENT

The Department of Geosciences at Texas Tech University (TTU) invites applications for a tenure-track faculty position in Atmospheric Science to begin in Fall 2017. The position will be filled at the Assistant Professor level. A Ph.D. in Atmospheric Science or a closely related field is required at the time of appointment. The successful candidate will establish an innovative, externally-funded academic research program, instruct graduate and undergraduate courses, and direct M.S. and Ph.D. student research. Service duties include program-building, as well as commitment to extra-curricular activities. Service to the department, college, and university is expected. Applicants whose research program can contribute to University strategic priorities in areas such as climate and hydrology are especially encouraged to apply, but consideration will be given to other tangential disciplines that have exceptional promise of growth.

The Department web site (www.geosciences.ttu.edu) describes the laboratories, facilities and current research programs. TTU has assembled a unique array of capabilities for observation and simulation of the atmosphere (e.g., the TTU High Performance Computing Center, two mobile high-frequency (Ka-band) Doppler radars, 24 StickNet in situ observation stations, the 98-station West Texas Mesonet, a 200-m tower instrumented at 10 levels). A newly renovated electronics lab is available to support the development and maintenance of field instrumentation. The department also is well positioned for research involving GIS and remote sensing. The interdisciplinary Climate Science Center (www.depts.ttu.edu/csc/) includes research involving education, climate modeling, and societal impacts of climate change. Collaborations also are possible with the local NWS and USGS offices.

Applicants must first visit the TTU employment website at http://jobs.texastech.edu. Once there, select "Faculty" then "Search Openings", search for requisition number 8789BR, and provide the required information. Afterwards, applicants must submit a letter of application, curriculum vitae, a statement of teaching and research interests, names and contact information (including e-mail address) of at least three professional references. These documents must be uploaded to the employment website. Inquiries regarding the position should be sent to Chris.Weiss@ttu.edu.

Review of applicants will begin 15 November and will continue until the position is filled.

TEXAS TECH UNIVERSITY IS AN AFFIRMATIVE ACTION/EQUAL OPPORTUNITY EMPLOYER, COMMITTED TO EXCELLENCE THROUGH DIVERSITY. TEXAS TECH WELCOMES APPLICATIONS FROM MINORITIES, WOMEN, VETERANS AND PERSONS WITH DISABILITIES.

EARL is a water analysis lab that supports teaching and research by students and faculty.

Applications will be accepted until the position is filled, with screening to begin immediately. The appointment will begin January 1, 2017. Applicants must submit, in PDF format, a brief letter of application describing their qualifications for the position, curriculum vitae, statement of teaching and research interests, and the names and addresses of three references to Jolene .marsh@und.edu.

ENDOWED DISTINGUISHED PROFESSORSHIP IN GEOLOGICAL SCIENCES

The University of Texas at San Antonio (UTSA) invites applications from senior scholars in the field of Hydrology to fill a tenured position at the Professor or Associate Professor level, subject to qualifications, to begin Fall 2017. The successful candidate will be awarded the Dr. Weldon W. Hammond, Jr. Endowed Distinguished Professorship in Geological Sciences. Read more about the endowed chair at http://www.utsa.edu/geosci/pdf/wwh_endowment_brief.pdf.

The Department of Geological Sciences aspires to be recognized for research strength in hydrology. We currently offer B.S. and M.S. degrees in Geology, and through affiliation, Ph.D. degree in Environmental Science and Engineering. Multi-disciplinary collaboration with other departments is encouraged, commonly through research centers such as the Center for Water Research, the Water Institute of Texas, and the Texas Sustainable Energy Research Institute. The successful candidate is expected to establish an externally funded research program that will expand the impact of our existing strengths in hydrology. Quality teaching will be expected at both the graduate and undergraduate levels. Responsibilities will include outreach to the multi-disciplinary scientific community in the San Antonio region, and service for the University, College, and Department.

Full Professor Required qualifications: Applicants must have a Ph.D. in Geoscience or a closely related discipline, with a sustained record of scholarly study in the geological sciences. Preferred qualifications: Active research in broad areas of hydrology. A nationally or internationally recognized record of academic excellence with an outstanding record of peer-reviewed scholarship, grant activity, and evidence of inspired teaching and graduate student supervision.

Associate Professor Required qualifications: Applicants must have a Ph.D. in Geoscience or a closely related discipline, with a substantial record of scholarly study in the geological sciences. Preferred qualifications: Active research in broad areas of hydrology. An active research program as demonstrated by a significant record of peer-

Georgia Institute of Technology
Faculty Position in Climate Sciences

The School of Earth and Atmospheric Sciences at Georgia Tech invites applications for tenure-track faculty positions in climate sciences. We are seeking candidates interested in understanding the mechanisms of the climate system through a variety of approaches, including theory, development and application of models of variable complexity, and synthesis of observational data. Areas of particular interest to the department include atmospheric and climate dynamics, ocean-atmosphere interactions, extreme weather events, land-atmosphere interactions, hydroclimate, cryosphere, and paleoclimate. We anticipate several climate-related hires in coming years, and are seeking to establish the school as a leader in both the fundamental science of climate and in addressing climate change with scientifically driven solutions. Applicants at the Assistant Professor level are sought, although outstanding individuals at all levels will be considered. The successful candidate will develop a vibrant research program in a dynamic interdisciplinary environment, teach, support and mentor students from diverse backgrounds at both undergraduate and graduate levels.

Georgia Institute of Technology is located in Atlanta, Georgia and is consistently a top ranked educational and research institution. For more information about our School and academic programs, visit www.eas.gatech.edu. Applicants should send an application letter, curriculum vitae, a statement of research and teaching interests, and the names and contact information for at least three references through the online portal at: https://academicjobsonline.org/ajo/jobs/8099. Requests for information and pre-application enquiries from senior candidates should be directed to Dr. Jean Lynch-Stieglitz, Search Committee Chair, at jean@eas.gatech.edu. Applications will be considered beginning December 1, 2016, but the search will continue until the positions are filled. An earned doctorate is required before start of employment. Georgia Institute of Technology an equal education/employment opportunity institution.

reviewed publications and external funding, and a record of outstanding teaching and graduate student supervision.

To apply for either the Associate or Full Professor, please click: https://jobs.utsa.edu/postings/4634

Required Supporting Documents:

- Cover Letter, including the level of position for which applying
- Curriculum Vitae
- Research Statement
- Teaching Statement
- Two representative publications
- List of three professional references with names, postal and e-mail addresses, telephone numbers

Applicants who are selected for interviews must be able to show proof that they will be eligible and qualified to work in the United States by time of hire. Finalists for this position will be subject to a pre-employment criminal background check. Tenure is contingent upon Board of Regents approval. Review of completed applications will begin on November 18, 2016, and continue until position is filled. Questions about the position can be directed to the search committee chair Dr. Judy Haschenburger (210-458-8592; judy.haschenburger@utsa.edu).

UTSA is an Affirmative Action/Equal Opportunity Employer. Women, minorities, veterans, and individuals with disabilities are encouraged to apply. Further information about the participating departments and UTSA is available on our Web page: http://www.utsa.edu/geosci/.

INTERDISCIPLINARY

Faculty Position in Environmental and Water Resources Engineering (EWRE), Tufts University

The Department of Civil and Environmental Engineering at Tufts University seeks candidates for a tenure-track faculty position in the area of Environmental and Water Resources Engineering at the level of Assistant Professor. Exceptional candidates may also be considered for appointment at the rank of Associate Professor depending on experience and accomplishments. Candidates must possess a doctorate degree in hydrology, environmental engineering, water resources engineering, engineering systems, or a related interdisciplinary field.

We seek applicants with expertise in the area of hydrology and water resources, whose research interests relate to complex water challenges facing society—including but not limited to food-energywater nexus, issues of scales and uncertainties, impacts of changing climate, and issues related to water resources access, allocation and management. Preference will be given to candidates with a proven record of scholarship and a focus on theory-practice synthesis. Principal responsibilities include the establishment of an externally-funded research program, graduate and undergraduate instruction and mentorship, and University and professional service. The successful candidate will join our Environmental and Water Resources Engineering program with strengths in hydrology, groundwater remediation, water quality modeling, water diplomacy, and contaminant fate and transport. The position offers considerable opportunity for collaboration in several interdisciplinary programs and organizations including Water: Systems, Science, and Society, Water Diplomacy, Tufts Institute of the Environment, and the Stockholm Environment Institute U.S. Office.

The Tufts School of Engineering (SOE) distinguishes itself by the interdisciplinary focus and integrative nature of its engineering education and research programs, within the intellectually rich environment of both a "Research 1" university and a top-ranked undergraduate institution. The past ten years have been a period of extraordinary growth for SOE at Tufts, with recruitment of over half of its current tenured and tenure-track faculty members and a more than three-fold increase in research productivity. Tufts offers the best of a liberal arts college atmosphere, coupled with the intellectual and technological resources of a major research university. Home to seven graduate and professional schools across three campuses, Tufts University prides itself on its culture of cross-school partnerships. Located on Tufts' Medford/Somerville campus, only six miles from historic downtown Boston, SOE faculty members have extensive opportunities for academic and industrial collaboration, as well as participation in the rich intellectual life of the region.

Questions about the position should be addressed to Professor Shafiqul Islam, search committee chair; Shafiqul.Islam@tufts.edu. Candidates should submit their application, including a cover letter, curriculum vitae, statement of research and teaching interests and objectives, and contact information for three references through Interfolio at https://apply.interfolio.com/38646. Review of applications will begin on December 1, 2016 and will continue until the position is filled; applications submitted after December 1 are also welcome. Tufts University is an Affirmative Action/Equal Opportunity Employer. We are committed to increasing the diversity of our faculty, and thus, women and members of underrepresented groups are strongly encouraged to apply.

Lindahl Ph.D. Scholarships

Lindahl Ph.D. Scholarships: The University of Alabama, Department of Geological Sciences seeks Ph.D. students with specializations that complement faculty research interests.

Swiss Federal Institute for Forest, Snow and Landscape Research WSL

The Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) is part of the ETH Domain. It employs approximately 500 people working on the sustainable use and protection of landscapes and habitats and a responsible approach to handling natural hazards. The research unit Landscape Dynamics analyses changes in the landscapes and ecosystems and is looking for a new

Groupleader Dendro Sciences

As a researcher with long-term experience and international reputation, you will manage the group and the tree-ring laboratories. You will promote and coordinate the research of the Dendro Sciences Group and perform your own projects. Furthermore, you will procure third party funding for research projects and encourage cooperation with other research groups of WSL, other institutes and organizations at both national and international level.

You will have a PhD in a natural science or related fields, an excellent international record in tree-ring research and are experienced in managing teams and projects. Additionally, you will have an integrative personality with good negotiating skills and are willing to coordinate and support the Dendro Sciences Group across a broad range of topics. You are fluent in English, and a good knowledge of one of the Swiss national languages will be advantageous.

Please send your complete application online to Sabine Hirt, Human Resources WSL. PD Dr. Matthias Bürgi, Tel. +41 (0)44 739 23 54, will be happy to answer further questions. The WSL strives to increase the proportion of women in its employment, which is why qualified women are particularly called upon to apply for this position.

Exceptional students will receive Research or Teaching Assistantships and a Lindahl Scholarship totaling $22,000 for a nine month appointment, and the cost of non-resident tuition is covered. Funding is renewable for 4 years if expectations are met. Other fellowships are available from the Graduate School. Further details are at http://www.geo.ua.edu/. Applicants should contact Dr. Robinson (dmr@ua.edu) to express interest. Review of applications for Fall 2017 admission will begin January 15, 2017.

Postdoctoral Fellowships

The Geophysical Laboratory, Carnegie Institution of Washington, invites applications for postdoctoral fellowships. The Geophysical Laboratory emphasizes interdisciplinary experimental and theoretical research in fields spanning geoscience, microbiology, chemistry, and physics. The Laboratory supports world-class facilities in high-pressure research; organic, stable isotope and biogeochemistry; mineral physics and petrology; and astrobiology.

Please visit https://jobs.carnegiescience.edu/jobs/carnegie-fellowships-for-the-geophysical-laboratory-4/ to view a list of required materials and application instructions. Also, see http://www.gl.ciw.edu/ for a listing of personnel, current research interests, and major facilities.

Completed applications for Carnegie fellowships should be submitted by November 30, 2016.

The Geophysical Laboratory is located in Washington, DC, and is an equal opportunity employer.

Postdoctoral Scholars in Ecosystem Monitoring and Modeling

Northern Arizona University seeks two postdoctoral researchers to participate in research projects focused on mapping, monitoring and modeling ecosystem changes, incorporating climate, land use and disturbance dynamics. The successful candidates will work closely with the principle investigator and collaborators, incorporating satellite observations in models to analyze the influence of various factors on forested and arctic ecosystem dynamics. This position requires advanced remote sensing experience, including the ability to manipulate large data sets using personally developed scripts. The position will involve processing multi-sensor imagery, primarily satellite-based but also airborne remote sensing, to derive geospatial products characterizing ecosystem properties (e.g. canopy structure, biomass, disturbance severity, regrowth dynamics). The research will advance analyses of ecosystem disturbance and the drivers of composition and change through time. Exploration of state-of-the-art techniques to derive geophysical properties in permafrost environments is desirable. Ability to synthesize complex information and develop structured analyses in written and visual form is essential.

The qualified candidates should have a PhD in Environmental Science, Remote Sensing, Computer Science and/or a related discipline, with experience using earth observation imagery and a demonstrated ability to write scripts, conduct spatial analysis and manage large data sets. Applicants should be confident in using a variety of software/geospatial tools and possess the ability to continuously learn new technical skills as needed. Publishing findings in peer-reviewed venues is a priority.

NAU is a committed Equal Opportunity/Affirmative Action Institution.

Science and Applications Branch Chief Opportunity – U.S. Geological Survey, Earth Resources Observation and Science (EROS) Center

The USGS EROS Center near Sioux Falls, SD is seeking a Science and Applications Branch Chief to lead one of the world's largest remote sensing and land change science research programs. The EROS Science and Applications Branch is composed of nearly 100 government and contract scientists, engineers, and technicians who conduct science and applications projects across the US and around the world.

The EROS mission is to contribute to the understanding of a changing Earth. EROS is a USGS science center, a key NASA Earth observations partner, and the operational home and steward for the Landsat program. The EROS Science and Applications program uses Landsat and other remotely sensed data to provide authoritative land change science information and knowledge that aids understanding how changes in land use, cover, and condition affect people and natural systems. As part of the USGS Climate and Land Use Change Mission, the EROS science program focuses on national to global land change issues. The specific goals of the EROS science and applications program include:

1. Improve land change monitoring through remote sensing research.
2. Understand the temporal and geographic dimensions of land change.
3. Improve the understanding of the connections between climate and land change and their combined impacts on human and natural systems.

The selected EROS Science and Applications Branch Chief leads the EROS research team addressing the EROS science goals and plays a key role in implementing a transformative center-wide capability to (1) continuously track and characterize changes in land cover, use, and condition and (2) translate the information into scientific assessments of current and historical processes of change that support evaluations and decisions relevant to climate change, environmen-

tal management, and public policy. The Branch Chief is a member of the EROS Executive Leadership Team and represents the role of science in shaping the strategic direction of the EROS Center.

A PhD in a relevant discipline and at least 10 years of experience in land change science and remote sensing research, leadership, and management is desirable. Candidates should have a proven record of science impact nationally and internationally. The salary range is $117,376.00 to $152,593.00/per year.

For specific questions about this position, contact John Hahn (EROS Deputy Director) at jhahn@usgs.gov, 605-594-2822

DEU, Job Announcement Number RES-2017-0026

https://www.usajobs.gov/GetJob/ViewDetails/454307200/

Merit Promotion, Job Announcement Number RES-2017-0027 https://www.usajobs.gov/GetJob/ViewDetails/454310400/

Tenure-Track Assistant Professor in Earth Systems Ecology or Ecohydrology

The College of Earth and Mineral Sciences at The Pennsylvania State University invites applicants for a Tenure Track Assistant Professor in Earth Systems Ecology or Ecohodrology. This position could include the study of interactions among terrestrial or aquatic ecosystems, climate/environmental change, the water cycle, humans, land use/land cover change, energy-related processes and biogeochemical cycling at landscape, regional, or global scales in the contemporary, prehistoric, or deep time periods. The successful candidate would have strengths in areas such as Earth system modeling, spatially explicit vegetation modeling, remote sensing, networked observations, model-data synthesis,

Faculty Position

Inst. of Undersea Tech. seeks research partners to work in underwater electro-mechanical systems, underwater acoustic signal processing or related areas for tenure-track positions at Assistant/Associate/Full Professor level. Applicants must hold a Ph.D. in engineering or oceanography with proven records of accomplishments, and are expected to establish research and teaching programs at the graduate level. Effective communication in English and collaborative skills are essential. Please submit application letter, curriculum vitae, publications list, research and teaching plan, and three references to: Prof. C. Wang, Inst. of Undersea Tech., National Sun Yat-sen University, Kaohsiung, Taiwan 804. Review process begins on Jan. 2, 2017. Detailed information is available at http://iut.nsysu.edu.tw/

FACULTY POSITION IN
SPACE SYSTEMS ENGINEERING

ASU School of Earth & Space Exploration
Arizona State University

The School of Earth and Space Exploration (SESE) at Arizona State University invites applications for an **Assistant or Associate Professor** with **expertise in space systems and technology**, to begin August 2017.

Minimum Qualifications: experience in space systems and technology and a Ph.D. in a related discipline; evidence of scholarly contributions in space systems and technology; and a commitment to quality university teaching.

To apply, please submit to sesenewfac@asu.edu the following: 1) a cover letter; 2) a current CV; and 3) the contact information of three references.

https://sese.asu.edu/about/opportunities/faculty-positions.
Refer to Position #11737.

Initial deadline for complete applications is December 15, 2016.

SESE

Arizona State University is a VEVRAA Federal Contractor and an Equal Opportunity/Affirmative Action Employer. All qualified applicants will be considered without regard to race, color, sex, religion, national origin, disability, protected veteran status or any other basis protected by the law. http://www.asu.edu/aad/manuals/acd/acd401 http://www.asu.edu/titleIX/

The School of Earth & Space Exploration is an academic unit of the College of Liberal Arts and Sciences

Department of Geosciences
PRINCETON UNIVERSITY

HARRY HESS FELLOWS PROGRAM

The Department of Geosciences at Princeton University announces competition for the 2016-2017 Harry Hess Fellows Program. This honorific postdoctoral fellowship program provides opportunities for outstanding geoscientists to work in the field of their choice. Research may be carried out independently or in collaboration with members of the Geosciences Department. One or more Hess Fellows may be appointed. Applicants must have obtained a Ph.D. at the time of the start of the fellowship, but not more than five years before. Current areas of research include:

- Biogeochemical Cycles
- Environmental Chemistry
- Geochemistry
- Geodynamics
- Geomicrobiology
- Mineral Physics
- Oceanography
- Geochronology
- Paleoclimatology
- Paleontology
- Petrology
- Seismology
- Tectonics
- Atmospheric Science
- Planetary Science
- Earth History

Applications are due on January 1, 2017, but evaluation of applications and interviews of candidates will begin immediately. Applicants should include a cover letter, a curriculum vitae including a publication list, a 1-2 page statement of research interests and goals, and name, address and email address of three referees familiar with their work by applying on the Princeton University jobsite at https://jobs.princeton.edu. Hess Fellowships provide a competitive annual salary, depending upon experience, along with a significant allowance for travel to meetings and for research support. Initial awards are for one year, with the possibility of renewal for additional years depending upon satisfactory performance and available funding. A preferred starting date is on or before September 1st, 2017. Applicants for the Hess Fellowship may also be considered for other available postdoctoral positions in the Geosciences Department.

Princeton University is an equal opportunity/ affirmative action employer and all qualified applicants will receive consideration for employment without regard to age, race, color, religion, sex, sexual orientation, gender identity or expression, national origin, disability status, protected veteran status, or any other characteristic protected by law. This position is subject to the University's background check policy.

Information about the research activities of the Department of Geosciences may be viewed at http://geoweb.princeton.edu.

biogeochemical cycles (e.g., C, N, and water), and coupled natural and human systems. Exemplary candidates at a higher rank will be considered. This position is co-funded by Penn State's Institutes of Energy and the Environment. The primary appointment would be in either the Department of Geography or Geosciences in the College of Earth and Mineral Sciences. The college is committed to fostering interdisciplinary research and education, and to broad searches for outstanding candidates. Thus, strong candidates will be considered across a broad range of disciplinary expertise. Candidates are expected to actively participate in the Intercollege Graduate Degree Program in Ecology and the EMS Earth and Environmental Systems Institute. Excellence in teaching, research, and service is also expected, as is the development of a vibrant externally funded research program. To apply please upload: 1) a letter describing your research and teaching plans; 2) a curriculum vitae; 3) up to four reprints; and 4) the names and addresses and contact information of four potential referees. Review of applications will begin December 15, 2016 but applications will be accepted until the position is filled. Questions about the position should be directed to the search committee chair, Dr. Alan H. Taylor, Department of Geography, The Pennsylvania State University, Phone: (814) 865-1509; E-mail: aht1@psu.edu.

Apply online at http://apptrkr.com/908244

CAMPUS SECURITY CRIME STATISTICS: For more about safety at Penn State, and to review the Annual Security Report which contains information about crime statistics and other safety and security matters, please go to http://www.police.psu.edu/clery/, which will also provide you with detail on how to request a hard copy of the Annual Security Report.

Penn State is an equal opportunity, affirmative action employer, and is committed to providing employment opportunities to all qualified applicants without regard to race, color, religion, age, sex, sexual orientation, gender identity, national origin, disability or protected veteran status.

Tenure-Track Assistant Professor Position in Environmental-Engineering Geology

The Department of Geology at Kansas State University is searching for a faculty member at the assistant professor level with expertise in Environmental / Engineering Geology, starting in August 2017. The successful candidate's research will emphasize water resources. Anticipated areas of specialization could include at least one of the following: geological/environmental engineering with focus on water resources, geohazard risk assessment and prediction, numerical modeling of flow in porous media and fracture networks, soil and vadose zone hydrology, remote sensing applied to hydrogeology/engineering geology, and hydro-mechanical coupling.

A detailed advertisement for the position is located: http://careers.k-state.edu/cw/en-us/job/497608/assistant-professorgeology. Screening of applications begins January 02, 2017 and continues until the position is filled. Full consideration will be given to applications received by January 02, 2017. Kansas State University is an EOE of individuals with disabilities and protected veterans. Kansas State University actively seeks diversity among its employees. Background check required.

Tenure-track faculty position—Geophysics and Geodynamics

The Department of Earth and Environmental Sciences at the University of Rochester invites applications for a tenure-track position in the broad field of geophysics and geodynamics. We anticipate hiring at the Assistant Professor level but exceptional candidates at the Associate and Full Professor level will be given full consideration. We are interested in dynamic educators and researchers who use experimental, computational and/or field approaches in their research and can establish externally funded, internationally recognized research programs that involve graduate students. The field of specialization is open, but preference will be given to individuals who can offer a research and teaching program that complements and expands upon our existing strengths in solid Earth processes and climate science. See http://www.ees.rochester.edu for more information about the Department's strengths in geochemistry, geophysics, tectonics, and climate science. We also encourage interdisciplinary applicants who can bridge the gap between traditional Earth Science and planetary science, as well as applicants who can utilize other outstanding research facilities at the University, including the Laboratory for Laser Energetics http://www.lle.rochester.edu and the Goergen Center for Data Sciences https://www.rochester.edu/data-science/.

The University of Rochester is a highly ranked research university, and the Rochester area's cultural, educational, and recreational assets frequently place it among the best places to live, work, and raise a family in the United States. Applicants should submit materials via: https://www.rochester.edu/faculty-recruiting Materials include a curriculum vitae, select reprints, statements of research and teaching goals, and the names and contact information of four references. The review of applications will begin December 31 2016 and will continue until the position is filled. The preferred start date for the position is July 1 2018. The University of Roches-

POSTDOCTORAL RESEARCH AND VISITING RESEARCH SCIENTISTS
ATMOSPHERIC AND OCEANIC SCIENCES
PRINCETON UNIVERSITY/GFDL

In collaboration with NOAA's Geophysical Fluid Dynamics Laboratory (GFDL), the Atmospheric and Oceanic Sciences Program at Princeton University solicits applications to its Postdoctoral and Visiting Research Scientist Program.

The AOS Program and GFDL offer a stimulating environment with significant computational and intellectual resources in which to conduct collaborative or independent research. We primarily seek applications from recent Ph.D.s for postdoctoral positions but will accept applications from more experienced researchers. Applications from independent researchers and more senior scientists who may need partial support for sabbatical or short visits may also be considered. Postdoctoral or more senior appointments are initially for one year with the possibility of renewal for a second year based on satisfactory performance and continued funding. A competitive salary is offered commensurate with experience and qualifications.

We seek applications in all areas of the climate sciences. This includes research in basic processes in atmospheric and oceanic dynamics; climate dynamics, variability and prediction; atmospheric physics and chemistry; cloud dynamics and convection; boundary layer processes; land-sea-ice dynamics; continental hydrology and land processes; physical oceanography; ocean-atmosphere interaction; climate diagnostics and analysis. Applicants must have a Ph.D. in a relevant discipline.

Further information about the Program may be obtained from: http://www.princeton.edu/aos/. Applicants are strongly encouraged to contact potential hosts at GFDL and Princeton University prior to application to discuss areas of possible research.

Complete applications, including a CV, copies of recent publications, at least 3 letters of recommendation, and a titled research proposal should be submitted by January 15, 2017 for full consideration. Applicants should apply online to http://jobs.princeton.edu, Requisition #1600924. We encourage applications from women, under-represented minorities, veterans and those with disabilities. These positions are subject to the University's background check policy. Princeton University is an equal opportunity employer and all qualified applicants will receive consideration for employment without regard to age, race, color, religion, sex, sexual orientation, gender identity, or expression, national origin, disability status, protected veteran status, or any other characteristic protected by law.

ter, an equal opportunity employer, has a strong commitment to diversity and actively encourages applications from candidates from groups underrepresented in higher education.

EOE / Minorities / Females / Protected Veterans / Disabled

Tenure-Track Professor in Climate Science

The Department of Earth and Planetary Sciences (EPS) and the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) plan to make a series of hires in the area of climate, beginning with two positions at the assistant, associate (untenured) or full professor (tenured) level with an expected start date of July 1, 2017. We invite applications in the broad area of climate science, including the oceans, cryosphere, land, and atmosphere, as well as their interactions. Approaches involving observations, theory, experiments, and modeling using biology, chemistry, or physics are all welcome. We are especially interested in candidates that will expand and complement existing strengths in climate science within EPS and SEAS.

A doctorate or terminal degree in the broad area of climate science is required by the expected start date. We also seek candidates who have a commitment to teaching.

Required application documents include a cover letter, curriculum vitae, three representative publications, a statement of research and teaching interests, and contact information for 3–5 potential references. We will evaluate applications beginning November 15th, and will conclude when the positions are filled. EPS and SEAS value diversity among their faculty, and we are committed to building a culturally diverse intellectual community. We particularly encourage applications from historically underrepresented groups, including women and minorities.

Further information about EPS and SEAS are available at http://www.eps.harvard.edu/ and http://www.seas.harvard.edu/. Address questions about the position to Professor Peter Huybers (phuybers@fas.harvard.edu) or Professor Frank Keutsch (keutsch@seas.harvard.edu) and about the application process to Kathleen McCloskey (kmccloskey@fas.harvard.edu).

We are an equal opportunity employer and all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability status, protected veteran status, or any other characteristic protected by law.

The Jonathan O. Davis Scholarship

The Jonathan O. Davis Scholarship supports graduate students working on the Quaternary geology of the Great Basin. The national scholarship is $7,500 and the University of Nevada, Reno stipend is $7,500. The national scholarship is open to graduate students enrolled in an M.S. or Ph.D. program at any university in the United States. The Nevada stipend is open to graduate students enrolled in an M.S. or Ph.D. program at the University of Nevada, Reno. Applications must be post-marked or submitted electronically by February 17, 2017. Details on application and submission requirements can be found at: http://www.dri.edu/GradPrograms/Opportunities/JonathanDavis. Proposals will not be returned.

Two Tenure-Stream Faculty Positions

The Department of Earth and Environmental Sciences at Michigan State University [MSU] is searching for two tenure-stream Assistant Professors starting Fall 2017. Exceptional candidates at Associate or Full Professor level will also be considered. Both positions include an enhanced level of flexible research funding from endowment resources.

Global Change Processes:

We seek a global change geoscientist focused on near-surface environments. Areas of emphasis could include sediment transport, the cryosphere, environmental geophysics, stable isotope geochemistry, geochronology, geobiology, and ocean/atmospheric circulation.

Geophysics:

We seek a geophysicist who will complement our current strengths in lower mantle dynamics, mineral physics, surface tectonics, and geochemistry. We especially encourage applicants with expertise in seismology.

Review of applications will begin on December 10, and continue until the positions are filled. Further details and instructions for applying can be found on jobs.msu.edu, posting 2591.

Please direct questions to Michael Gottfried at gottfrie@msu.edu, copied to eeshire@msu.edu. MSU is an affirmative action, equal opportunity employer and is committed to achieving excellence through diversity. All qualified applicants will receive consideration without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability status, protected veteran status, or any other characteristic protected by law. We endeavor to facilitate employment assistance to spouses or partners of candidates for faculty and academic staff positions.

Weiss Visiting Professor

We are soliciting applications for the Wiess Visiting Professor in the Department of Earth Science at Rice University. Our department has lively research programs in

1. Carbonate and Clastic Sedimentology and Coastal Processes
2. Paleoclimatology

GEOMAR
Helmholtz Centre for Ocean Research Kiel

C | A | U
Kiel University
Christian-Albrechts-Universität zu Kiel

Kiel University and GEOMAR Helmholtz Centre for Ocean Research Kiel intend to attract more qualified women for professorships.

The Faculty of Mathematics and Natural Sciences at Kiel University, Germany, and GEOMAR Helmholtz Centre for Ocean Research Kiel jointly invite applications for the following position to be filled as soon as possible:

Junior Professorship (W1) in Theoretical Physical Oceanography

which is initially appointed for 3 years („Beamtenverhältnis auf Zeit"). After positive evaluation, the position will be extended by up to 3 additional years. The junior professorship is embedded at GEOMAR Helmholtz Centre for Ocean Research Kiel in the research unit "Theory and Modelling" which is part of the research division "Ocean Circulation and Climate Dynamics".

The junior professor is expected to initiate and lead excellent and internationally recognized research in the area of ocean dynamics and contribute to the theoretical understanding of the general ocean circulation and its role in climate variability. We are looking for a candidate with research experience and interests in one or more of the following fields:

- theory of the large-scale ocean circulation and its variability
- ocean mixing associated with mesoscale or submesoscale eddies and its parameterisation for use in ocean models
- development and implementation of inverse methods to aid interpretation of observational datasets
- dynamical concepts for data assimilation

The junior professorship will thematically and methodically enhance the existing capacity of the research unit. It shall foster and expand the existing collaboration within the research division and across disciplines in Kiel Marine Sciences.

The junior professor is required to participate in the educational programme of ocean and climate physics by teaching in theoretical oceanography at both the undergraduate and graduate level. The teaching commitment is 4 semester hours per week. It is required that lectures can be given in English. The willingness to teach in German within 3 years is expected.

A requirement of the position is a doctoral degree. The position has been opened with respect to Art. § 64 of the "Higher Education Act" of the State of Schleswig-Holstein. General information can be found at the homepage www.berufungen.uni-kiel.de. For additional information about the position please contact Prof. Dr. Arne Biastoch (abiastoch@geomar.de). Detailed information about the GEOMAR Helmholtz Centre for Ocean Research Kiel can be found under www.geomar.de.

Kiel University and GEOMAR Helmholtz Centre for Ocean Research Kiel both wish to increase the number of female scientists in faculty positions and encourage applications of qualified women. Female applicants will be given priority if their qualifications and achievements are equal to those of male applicants. Applications from scientists with disabilities will be given priority in case of equal qualifications. We explicitly encourage candidates with a migration background to apply. Please refrain from submitting photographs.

Applications should be written in English and include (1) cover letter; (2) curriculum vitae including certificates of academic degrees, list of publications, past and present funding and information on teaching experience; (3) statement of previous and future research interests and (4) a teaching plan. Applications together with private and academic mailing and e-mail addresses and telephone number should be submitted by **December 31, 2016** to The Dean, Faculty of Mathematics and Natural Sciences, Kiel University, D-24098 Kiel, Germany.

3. Atmospheric Chemistry
4. Biogeochemistry
5. Geobiology
6. Low and High Temperature Geochemistry
7. Petrology
8. Rock Physics and Geomechanics
9. Environmental, Exploration, Solid Earth and Theoretical Seismology
10. Crustal and Mantle Structure and Geodynamics
11. Planetary Science

We invite applications from established scientists whose research falls in any of these areas, and request that you identify one or more of our faculty whose research interests overlap yours. The department is characterized by collegiality and interdisciplinary research. Our faculty have ties to the Rice Departments of Biosciences, Chemistry, Computational and Applied Mathematics, Mechanical Engineering, and Physics and Astronomy. We also have strong ties to the local petroleum industry, the NASA Johnson Space Center, and the Lunar Planetary Institute.

The Wiess Visiting Professorship provides travel expenses to and from Rice, and living expenses while in residence, details are negotiable. Visiting Professors are typically in residence from a few months to a full academic year. Ideally Wiess Visiting Professors interact at a high level with members of our department, often through topical seminars. We particularly encourage women and minority geoscientists to apply.

See:
http://earthscience.rice.edu for more details about our Department, and
http://earthscience.rice.edu/directory/wiess-visiting-professor/ for a list of previous Wiess Visiting Professors.

Please provide a curriculum vita, research statement, and indication of availability. Applications and inquiries can be sent to

Chair, Wiess Visiting Professor Committee
Department of Earth, Environmental and Planetary Science
Rice University, MS-126
6100 Main Street
Houston, TX 77005
or
esci-search@rice.edu

Please put Wiess Visiting Professor on the subject line.

Rice University, located in Houston, Texas, is a private, coeducational, nonsectarian university that aspires to path-breaking research, unsurpassed teaching, and contributions to the betterment of our world. Rice fulfills this mission by cultivating a diverse community of learning and discovery that produces leaders across the spectrum of human endeavor. From its beginning in 1912, Rice has been dedicated to excellence in all regards.

Rice University is an Equal Opportunity Employer with commitment to diversity at all levels, and considers qualified applicants without regard to race, color, religion, age, sex, sexual orientation, gender identity, national or ethnic origin, genetic information, disability or protected veteran status.

MINERAL AND ROCK PHYSICS

University Lectureship in Multi-Scale, Multi-Dimensional Imaging of Natural and Synthetic Materials

Applications are invited for a lectureship in Multi-Scale, Multi-Dimensional Imaging of Natural and Synthetic Materials, to be held jointly in the Department of Materials Science and Metallurgy and the Department of Earth Sciences.

There is a rapidly growing community of materials scientists and Earth scientists who are using multi-dimensional imaging techniques, such as x-ray and electron tomography and time-resolved microscopy, coupled with advanced computational analysis and novel visualisation methods. These techniques are set to transform our understanding of natural and synthetic materials across a range of length scales, from tens of microns to the atomic scale. We are seeking candidates who can lead a research effort in this area, interact strongly with research groups in both Departments, and define the University as a world leader in multi-dimensional imaging techniques.

Applicants will be expected to have a PhD in Materials Science, Earth Sciences, Physics, Chemistry or a cognate subject, will have a track record of excellent research publications, and will be expected to lead and pursue a research programme of the highest standard. They will also supervise research students and actively seek external funds to support their research. The person appointed will also be expected to contribute to teaching in areas relevant to either Department at a teaching load comparable to that of colleagues in either Department.

A University Lectureship is broadly equivalent to a tenure track Assistant Professorship in the US.

Further particulars and information at http://www.jobs.cam.ac.uk/job/11794/.

OCEAN SCIENCE

International Faculty Cluster Hire in Geological Oceanography

The Department of Geological Oceanography (http://dgo.xmu.edu.cn) is expanding its international faculty with the addition of six (6) new positions planned for the second phase. Already one of China's top oceanography schools, the College (http://coe.xmu.edu.cn:82) aims to establish the Department of Geological Oceanogra-

phy as a premier center in land–ocean interactions, sedimentary processes/records, and global change. The ranks of the appointments are open, and are commensurate with the applicants' qualifications and experience.

At this time, we seek highly qualified candidates in three complementary and synergistic areas of study:

Stratigraphy/Geophysics/Seafloor Imaging – Two (2) positions are available in the general area are of seafloor imaging and subbottom profiling. Although all qualified candidates in this area will be considered, we are especially interested in candidates who apply state-of-the-art seagoing surface and/or subbottom mapping tools and analysis skills to the investigation of coastal and continental margin environments.

Sediment Transport Dynamics—Two (2) positions are available in the general area of observational sediment transport. We seek highly qualified candidates who use new and novel field approaches and tools to examine the flux and fate of terrestrial matter in and across continental margins, including rivers, estuaries, shelf and slope environments.

Numerical Modeling of Sediment Processes and Stratigraphy—Two (2) positions in numerical modeling are available in areas that support the observational program in land–ocean interaction and sedimentary records. Examples of areas that are of particular interest include, but are not limited to: 3-D modeling of sediment transport and deposition/erosion, stratigraphic modeling, seabed diagenesis, surface processes/fluvial geomorphology.

We seek applicants with proven record or promise to contribute to the interdisciplinary research and teaching missions of the College. A Ph.D. degree is required at the time of appointment and in the case of a Chinese degree two years in an overseas postdoctoral position.

In conjunction with the State Key Laboratory of Marine Environmental Science (http://mel.xmu.edu.cn/en/index.asp), the College has access to state-of-the-art instrumentation and offers internationally competitive compensation, start-up and relocation packages. Special recruitment programs are available to exceptionally well-qualified candidates. Xiamen University recently launched a 3600-ton (78 m) research vessel and is completing construction of a marine station for cutting-edge education and research in oceanography. XMU envisions the development of a world-class program in Geological Oceanography with focus on interdisciplinary studies of sediment processes and the sedimentary record in China's diverse marginal seas.

Xiamen University, located along China's SE coast, was founded in 1921 with the vision to become the leading international university in China

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

DEPARTMENT OF EARTH & ENVIRONMENTAL SCIENCES

Atmospheric Science Faculty Position

The Department of Earth and Environmental Sciences (DEES) of Columbia University seeks to fill a tenure-track Assistant Professor position in atmospheric science, broadly defined. The successful applicant is expected to develop a high-impact research program at Lamont-Doherty Earth Observatory (LDEO) focused on problems of global significance and to demonstrate strong potential for effective teaching at undergraduate and graduate levels. Applicants should submit a cover letter, CV, teaching and research statements, and name at least 3 references using our online site:

https://academicjobs.columbia.edu/applicants/Central?quickFind=63610

Review of applications will commence on December 19, 2016 and continue until the position is filled.

Columbia University is an Equal Opportunity/Affirmative Action employer, dedicated to fostering a culturally diverse and pluralistic teaching and research environment. We strongly encourage applications from women and members of underrepresented groups.

Applied Geoinformatics—Dartmouth College

The Department of Earth Sciences at Dartmouth College invites applications for a junior rank tenure-track position in the area of geoinformatics with application to one or more of our core research areas including i) ice and climate systems, ii) water and environmental biogeochemistry, and iii) planetary evolution and surface processes. We especially welcome applications from candidates who link traditional geologic approaches and state-of-the-art computational geoinformatics in their research. Particular attention will be given to candidates who combine a focus on understanding fundamental processes with laboratory and/or field research programs that complement and contribute to ongoing research activities in the Departments of Earth Sciences, Mathematics, and Computer Sciences, as well as the Thayer School of Engineering. The successful candidate will continue Dartmouth's strong traditions in graduate and undergraduate research and teaching. Teaching responsibilities consist of three courses spread over three of four ten-week terms.

The Department of Earth Sciences is home to 11 tenured and tenure-track faculty members in the School of Arts and Sciences, and enjoys strong Ph.D. and M.S. programs and outstanding undergraduate majors. To create an atmosphere supportive of research, Dartmouth College offers new faculty members grants for research-related expenses, a quarter of sabbatical leave for each three academic years in residence, and flexible scheduling of teaching responsibilities.

Dartmouth College has undergraduate and graduate student populations that are diverse by many measures. We seek applicants with a record of successful teaching and mentoring of students from all backgrounds (including first-generation college students, low-income students, racial and ethnic minorities, women, LGBTQ, etc.). Dartmouth provides opportunities to participate in undergraduate diversity initiatives in STEM research, such as our Women in Science Program, E. E. Just STEM Scholars Program, Academic Summer Undergraduate Research Experience (ASURE), and the Mellon Mays Undergraduate Fellowship.
Dartmouth, a member of the Ivy League, is located in Hanover, New Hampshire (on the Vermont border). Dartmouth has a beautiful, historic campus located in a scenic area on the Connecticut River. Recreational opportunities abound all year round.

To learn more about Dartmouth College and the Department of Earth Sciences, visit http://www.dartmouth.edu/~earthsci.

To submit an application, upload a cover letter, curriculum vitae, statements of teaching and research interests and objectives, reprints or preprints of up to three of your most significant publications, and the name, address (including street address), e-mail address and fax/phone numbers of at least three references to: https://apply.interfolio.com/37126

Application review will begin November 1, 2016, and continue until the position is filled. The appointment will be effective July 1, 2017.

Dartmouth College is an equal opportunity/affirmative action employer with a strong commitment to diversity. In that spirit, we are particularly interested in receiving applications from a broad spectrum of people, including women, minorities, individuals with disabilities, veterans or any other legally protected group.

(http://www.xmu.edu.cn/en/about/xmu_at_a_glance). Xiamen University has inter-university cooperative ties with over 270 institutions of higher education at home and abroad, including the establishment of a new campus in Malaysia (http://www.xmu.edu.my/a/5.html).

To apply email a cover letter, CV, contact information for 3-5 references, and a statement of research and teaching philosophy and goals to Dr. Steven A. Kuehl, Interim Chair, Department of Geological Oceanography (kuehl@xmu.edu.cn). Applications will be considered beginning February 1, 2017, however the positions will remain open until filled.

Tier I Canada Research Chair

The Department of Oceanography at Dalhousie University seeks applicants for a Tier I Canada Research Chair (CRC) in quantitative observational Biological Oceanography. This person will be an outstanding and innovative researcher, recognized as an international leader in this field, with a superior record of attracting and supervising graduate students and postdoctoral fellows.

The successful candidate will have a Ph.D. in oceanography, or a closely related field, and will be appointed at the rank of Associate Professor or higher, with tenure if qualifications and experience warrant. Review of applications will begin December 1, 2016, but continue until the position is filled. Anticipated start date is 1 July, 2017, or as negotiated.

Application and submission details are available in the expanded online version of this announcement at dal.ca/careers.

This Tier I CRC is reserved for external recruitment. Only candidates who are external to Dalhousie University may apply. Dalhousie is committed to fostering a collegial culture grounded in diversity and inclusiveness. The university encourages applications from qualified Aboriginal people, persons with a disability, racially visible persons, women, persons of minority sexual orientations and gender identities, and all qualified candidates who would contribute to the diversity of our community. All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority.

Tier II Canada Research Chair

The successful candidate must have a Ph.D. in physical oceanography or related field, and have demonstrated research excellence in GFD. The candidate is expected to make effective use of (i) state-of-the-art models to better understand, and possibly predict, changes in the physical properties of the deep ocean and/or adjacent shelf seas, and (ii) modern data assimilation techniques. The successful candidate must have the potential to develop a collaborative and productive research program that complements the ongoing research activities of the Department of Oceanography and other departments in the Faculty of Science, and also engage with the local, national and international research community.

The successful candidate will be appointed to a tenure stream position at the rank of Assistant or Associate Professor. Review of applications will begin on December 1, 2016 but applications will continue to be accepted until the position is filled. The anticipated start date is 1 July, 2017 or as negotiated. The application should include a detailed curriculum vitae, a two to three page description of current research and accomplishments, three representative publications, the names and contact information of three referees, and a completed Self-ID questionnaire which is available at www.dal.ca/becounted/selfid. Please send the complete application to

Professor Keith R. Thompson
Committee Chair ,Tier II CRC in GFD-PO
Department of Oceanography, Dalhousie University
GFD-PO@dal.ca

For a complete version of the advertisement see https://www.dal.ca/content/dam/dalhousie/pdf/faculty/science/oceanography/researchchair2.pdf

PLANETARY SCIENCES

Assistant Professor of Planetary Materials

The Department of Earth, Atmospheric, and Planetary Sciences (EAPS), within the College of Science, Purdue University, invites applications for a tenure-track faculty position at the rank of Assistant Professor in the area of Planetary Materials. The Planetary Science Group within EAPS has an international reputation, extensive involvement in spacecraft missions, and newly developed undergraduate and graduate programs. We seek to grow and are looking for someone who conducts laboratory analysis of planetary materials or their terrestrial analogues. Candidates must have completed their PhD in an appropriate field. The appointee is expected to develop and maintain a vigorous, externally funded, internationally recognized research program and to teach and mentor students at the undergraduate and graduate levels.

Applications should be submitted electronically at https://hiring.science.purdue.edu. Applications should include a curriculum vitae, a statement of research, a teaching statement, and contact information of three individuals who can provide letters of reference. Questions related to this position should be addressed to Dr. Chris Andronicos (candroni@purdue.edu),

Faculty Position in Earth and Atmospheric Sciences at Cornell University

Cornell is a community of scholars, known for intellectual rigor and engaged in deep and broad research, teaching tomorrow's thought leaders to think otherwise, care for others, and create and disseminate knowledge with a public purpose.

The Department of Earth and Atmospheric Sciences (EAS) at Cornell University invites applications for an Assistant Professor in the subject of large-scale atmospheric and climate dynamics. The successful candidate will develop a high quality research program investigating atmospheric systems and processes on large space and time scales, namely from regional to continental spatial scales and on seasonal to inner-annual time scales. Research areas could include, but not be limited to, climate-weather or ocean-atmosphere interactions. The selected candidate will be a committed educator, enthusiastically teaching undergraduate and graduate courses, advising undergraduates and graduate students, and supervising students at all levels in research. The responsibilities of the position will be 50% research and 50% teaching.

A Ph.D. in atmospheric science or a related science or engineering discipline is required. Please submit applications to Academic Jobs Online at **https://academicjobsonline.org/ajo/jobs/8042**. Inquiries may be directed to the Search Committee Chair at **sjc25@cornell.edu**. Application review will begin January 3, 2017.

Cornell University is an innovative Ivy League university and a great place to work. Our inclusive community of scholars, students and staff impart an uncommon sense of larger purpose and contribute creative ideas to further the university's mission of teaching, discovery and engagement. Located in Ithaca, NY, Cornell's far-flung global presence includes the medical college's campuses on the Upper East Side of Manhattan and in Doha, Qatar, as well as the new CornellNYC Tech campus to be built on Roosevelt Island in the heart of New York City.

Diversity and Inclusion are a part of Cornell University's heritage. We're an employer and educator recognized for valuing AA/EEO, Protected Veterans, and Individuals with Disabilities.

OAK RIDGE National Laboratory

Oak Ridge National Laboratory is seeking a **Nuclear Security Scientist – Secondary Ion Mass Spectrometry,** to focus on contributions to the uranium science team within the NSAT group through the investigation of solid state uranium compounds and related fuel cycle chemistries using high spatial resolution secondary ion mass spectrometry. The successful candidate will be the technical lead and primary user of a newly acquired Cameca NanoSIMS 50L as part of the Ultra-trace Forensic Science Center.

Ph.D. in Geochemistry, Chemistry, Physics or related field is required. Ability to hold and maintain a DOE Q security clearance is required. The ability to work flexible hours and travel are required.

ORNL is an equal opportunity employer. All qualified applicants, including individuals with disabilities and protected veterans are encouraged to apply. UT-Battelle is an E-Verify employer.

Please apply at our website www.ornl.gov/ornl/careers

Chair of the Search Committee. Review of applications will begin on December 1, 2016, and continue until the position is filled.

Purdue University is an EOE/AA employer. All individuals, including minorities, women, individuals with disabilities, and veterans are encouraged to apply.

University Lectureship in Exoplanetary Science

Applications are invited for a lectureship in exoplanetary science to be appointed jointly by the Department of Earth Sciences and the Institute of Astronomy (IoA). Candidates should have an outstanding record of research in Earth sciences, planetary sciences, and/or astronomy, with high potential for interdisciplinary research in exoplanetary science.

They will have a PhD in geosciences, planetary sciences, physics, astronomy, or an allied discipline relevant to exoplanetary science and will be expected to develop a vigorous research programme at an international level which is firmly grounded in both Departments.

The Department of Earth Sciences has broad interests in the chemical evolution of the Earth and solar system, with major expertise across petrology, mineral physics, meteoritics, geochemistry, cosmochemistry, volcanology, and geophysics. The IoA conducts forefront research across the breadth of astrophysics and cosmology and has a strong programme in exoplanetary science spanning exoplanet detection, exoplanetary atmospheres and interiors, planetary system dynamics and minor bodies, debris disks, protoplanetary disks and planet formation.

Applicants will be expected to contribute to the research activity of both Departments, interacting with academic staff across several areas, supervise research students and actively seek external funds to support their research. The person appointed will also be expected to contribute to teaching in areas relevant to either Department at a teaching load comparable to that of colleagues in either Department.

A University Lectureship is broadly equivalent to a tenure track Assistant Professorship in the US.

See: http://www.jobs.cam.ac.uk/job/11727

SOLID EARTH GEOPHYSICS

Assistant Professor - School of Earth and Space Exploration, Arizona State University

The School of Earth and Space Exploration (SESE) invites applications for an Assistant Professor with expertise in global geophysical processes. Anticipated start date is August 2017. We desire a candidate who (1) addresses fundamental questions in the dynamics, structure, and evolution of Earth and other planetary interiors, and (2) will work closely with existing geophysics faculty and has the ability to develop collaborations with other closely affiliated research programs in SESE (for example, possibilities include astrobiology, geochemistry, petrology, planetary science, surface processes, tectonics, and volcanology). We are interested in individuals showing capacity to bridge research in deep and shallow processes. Examples include how deep interior processes relate to the evolution of the lithosphere or the fluid envelopes of Earth and other planets. SESE is particularly interested in candidates with a strong track record in geodynamics.

Minimum qualifications

• Ph.D in Geophysics or related field by the time of appointment

• Established publication track record in Earth (or Earth and planetary) interior research

• Demonstrated expertise in geophysical methods aimed at understanding large-scale interior dynamical processes

• Demonstrated potential to establish a vigorous, externally-funded research program Commitment to quality teaching at the graduate and undergraduate levels.

Desired Qualifications:

• Research expertise as noted above

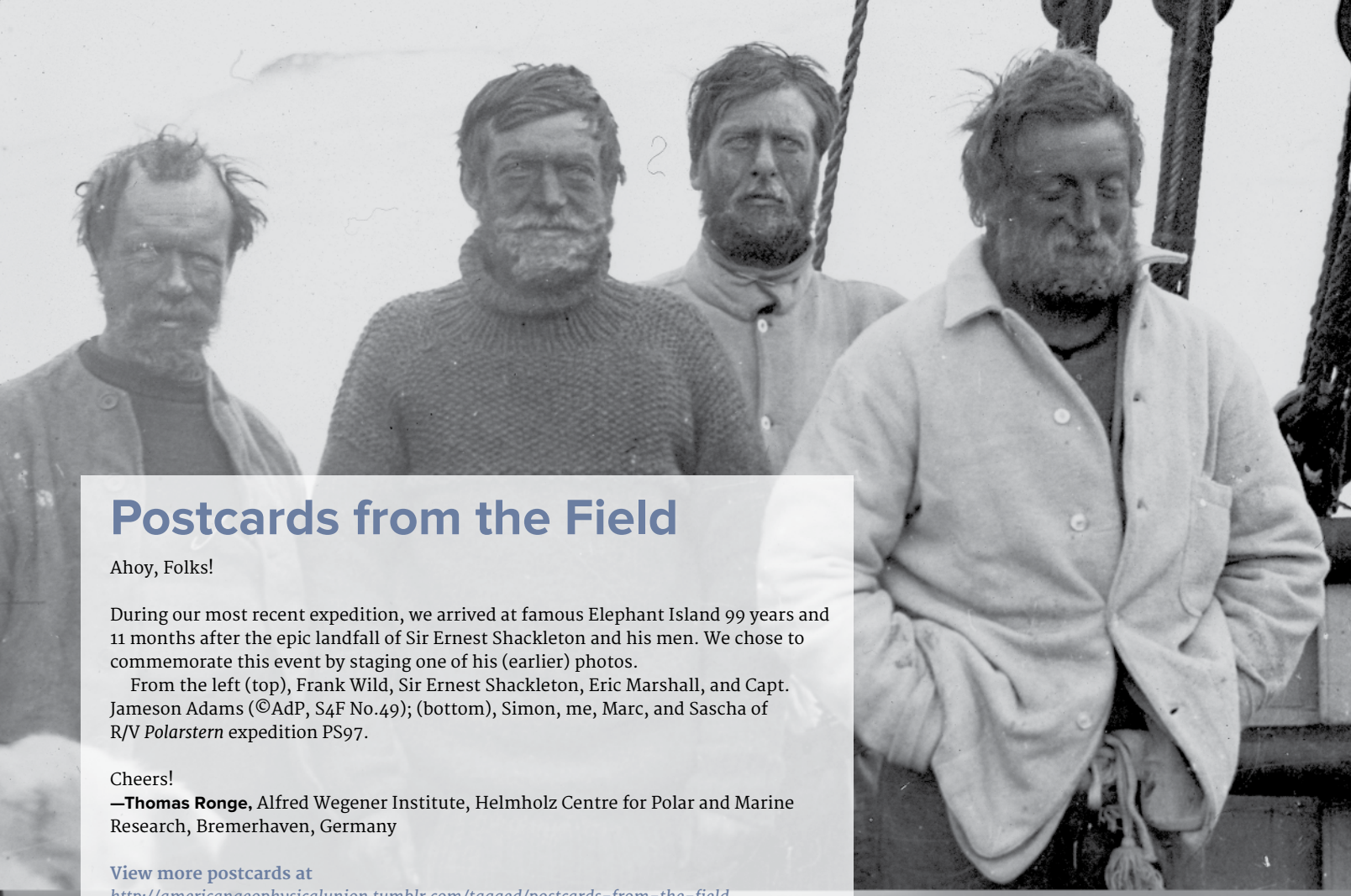
• Demonstrated success meeting the educational needs of diverse student populations and/or engaging in scientific outreach to diverse communities.

SESE brings together Earth and space science into one school, breaking traditional disciplinary boundaries to investigate the biggest questions. SESE combines the strengths of science, engineering, and education, to set the stage for a new era of exploration. See http://sese.asu.edu for more information, and https://sese.asu.edu/about/opportunities/faculty-positions.

To apply, please submit the following materials as a single PDF file: 1) a cover letter that includes a description of the applicant's research and teaching interests and experience, and indicate the Job number 11791 in your letter; 2) a current CV; and 3) the names, email addresses, institution, title, and telephone numbers of three references. Email the PDF of these application materials to sesenewfac@asu.edu.

Initial deadline for receipt of complete applications is December 30, 2016; if not filled, reviews will continue weekly until search is closed. A background check is required for employment.

Arizona State University is a VEVRAA Federal Contractor and an Equal Opportunity/Affirmative Action Employer. All qualified applicants will be considered without regard to race, color, sex, religion, national origin, disability, protected veteran status or any other basis protected by the law. http://www.asu.edu/aad/manuals/acd/acd401 http://www.asu.edu/titleIX/.



Postcards from the Field

Ahoy, Folks!

During our most recent expedition, we arrived at famous Elephant Island 99 years and 11 months after the epic landfall of Sir Ernest Shackleton and his men. We chose to commemorate this event by staging one of his (earlier) photos.

From the left (top), Frank Wild, Sir Ernest Shackleton, Eric Marshall, and Capt. Jameson Adams (©AdP, S4F No.49); (bottom), Simon, me, Marc, and Sascha of R/V *Polarstern* expedition PS97.

Cheers!

—Thomas Ronge, Alfred Wegener Institute, Helmholz Centre for Polar and Marine Research, Bremerhaven, Germany

View more postcards at
http://americangeophysicalunion.tumblr.com/tagged/postcards-from-the-field.

Provides Free Global Access to Research Presented at Fall Meeting

Sessions organized by channels, including:

- Climate
- Data & Rising Technologies
- Earth Processes
- Extreme Events & Hazards
- Geohealth
- Planetary Discovery
- Science & Society
- Union

Register or log in at:

AGUondemand.agu.org

Channel names are subject to change. The final program and AGU On-Demand channel listings will be published 3 October.

SHARING SCIENCE

Learn, Engage, Be Inspired!

All events are located in the Sharing Science Room (Moscone West: 2001A) unless otherwise noted.

Learn

Luncheon: How to Become a Congressional Science Fellow or Mass Media Fellow
Monday, 12:30 P.M.–1:30 P.M.
San Francisco Marriott Marquis, Golden Gate B

Sharing Science Communications Clinic
Monday, 2:30 P.M.–3:45 P.M.

Sharing Science in Plain English (Panel & Lunch)
Tuesday, 12:30 P.M.–2:00 P.M.

The Next Frontier: Lightning Comms Workshop for Established Scientists
Tuesday, 2:00 P.M.–3:45 P.M.

Meet the Filmmaker
Wednesday, 8:00 A.M.–10:00 A.M.

You Don't Have to Quit Your Day Job—Career Panel
Wednesday, 9:00 A.M.–11:00 A.M.
Career Center

Communicating Your Science: Ask the Experts
Wednesday, 10:30 A.M.–12:30 P.M.

Science Policy 101
Wednesday, 12:30 P.M.–1:30 P.M.
Moscone North, Rooms 120—121

Wearing the White Hat: Careers in Science Policy
Wednesday, 4:00 P.M.–5:00 P.M.
Career Center

Science Policy 201
Thursday, 11:30 A.M.–12:30 P.M.

Engage

Sketch Your Science
Monday–Friday, All day and be entered to win prizes!

Sharing Science Mentoring Meet-up
Monday, 1:00 P.M.–2:00 P.M.

Building an Online Presence/Using Social Media as a Jobseeker
Tuesday, 11:00 A.M.–12:00 P.M. & 4:00 P.M.–5:00 P.M.
Career Center

Science Policy Networking Lunch & Lounge
Tuesday, 12:00 P.M.–1:30 P.M.

Fall Meeting Tweetup
Tuesday, 3:30 P.M.–4:30 P.M.
AGU Booth

Sharing Science Networking Lounge
Wednesday, 12:30 P.M.–1:30 P.M.

Blogging and Social Media Forum 101
Wednesday, 2:00 P.M.–3:00 P.M.

Blogging and Social Media Forum 201
Wednesday, 3:00 P.M.–4:00 P.M.

Wikipedia Edit-a-Thon
Thursday, 1:00 P.M.–5:00 P.M.

Be Inspired

Public Lecture: How Do We Choose a Landing Site on Mars?
Sunday, 12:00 P.M.–1:00 P.M.
Moscone South, Room 102

AGU Cinema: Short Films on Science
Monday–Tuesday, 8:00 A.M.–12:00 P.M.
Thursday, 8:00 A.M.–11:00 A.M.
Friday, 8:00 A.M.–1:00 P.M.

Student Pop-Up Talks
Monday & Tuesday, 4:00 P.M.–6:00 P.M.

The Story Collider—Geosciences
Thursday, 8:00 P.M.–10:00 P.M.
Rickshaw Stop, 155 Fell St, San Francisco

Sharing Science Sessions

Bringing Science Communication into Curricula
Monday, 1:40 P.M.–6:00 P.M.
Moscone South, Poster Hall

Road Maps to Successfully Sharing Science
Wednesday, 8:00 A.M.–12:20 P.M.
Moscone South, Poster Hall

The Up-Goer Five Challenge: A Fun and Radical Way to Distill Your Science
Friday, 1:40 P.M.–3:40 P.M.
Moscone South, Room 320

AGU's Sharing Science program provides scientists with opportunities, tools, and support to effectively promote widespread awareness of Earth and space science and its value.

sharingscience.agu.org/agu16